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Fig. 1.

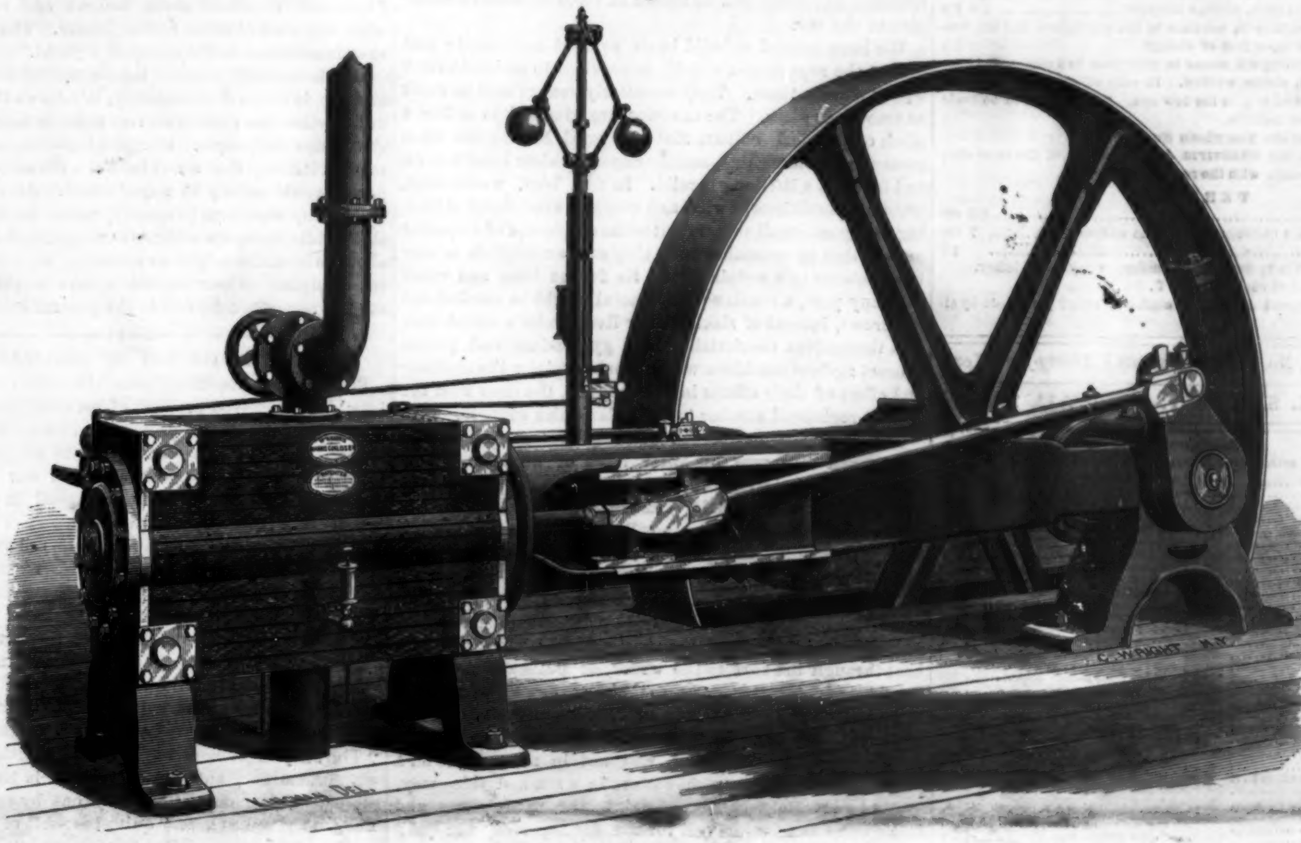
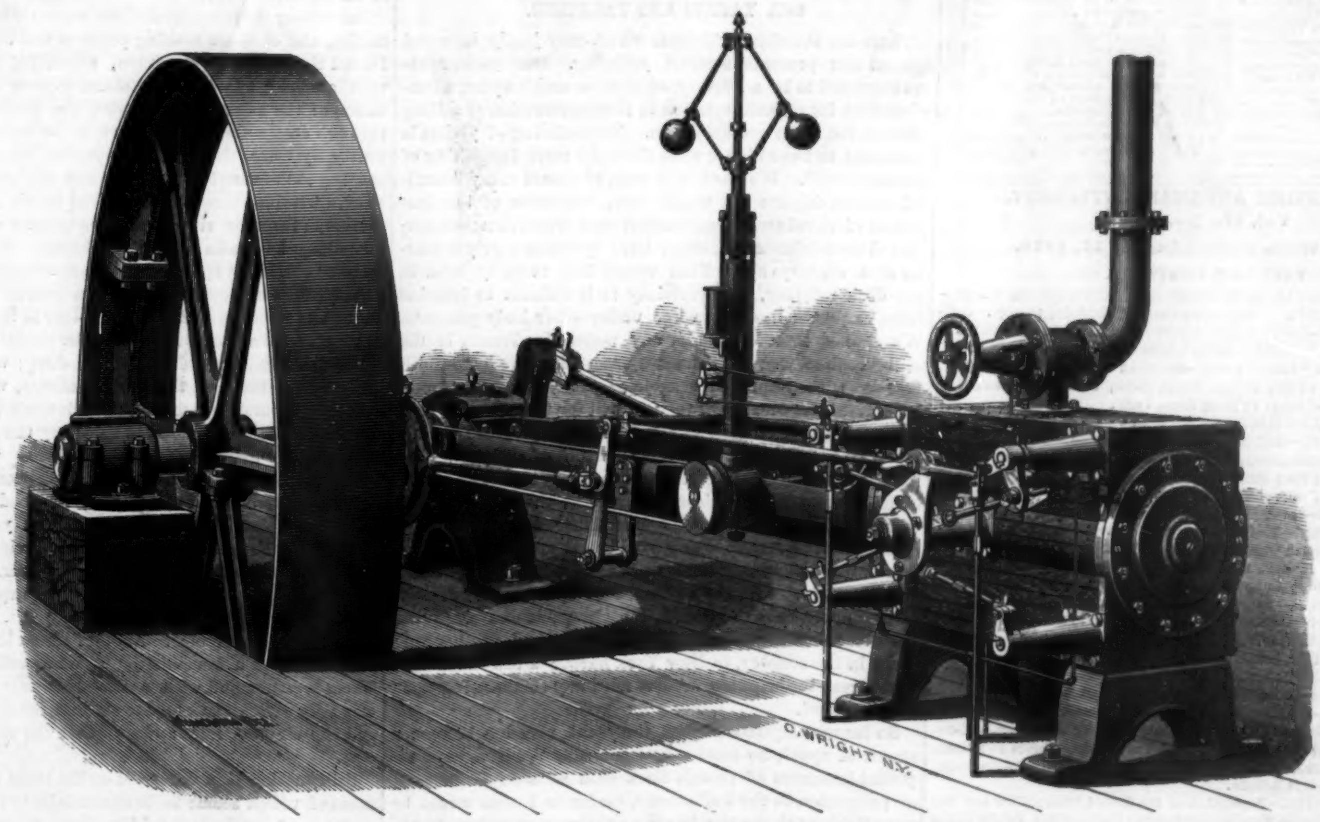


Fig. 2



THE IMPROVED HARRIS-CORLISS STEAM ENGINE.

NEW IMPROVEMENTS IN THE HARRIS-CORLISS STEAM ENGINE.

The Harris-Corliss steam engine has achieved so wide a celebrity, and has been brought so prominently into public notice of late years, through the trials which it has successfully undergone in several fairs, that we deem it unnecessary, in the present connection, to review in any detail the general construction of the machine. From the engravings, Figs. 1 and 2, herewith, showing both the crank and the valve gear sides, it will be perceived that the mechanism which moves the valves is outside the steam chest, hence susceptible to constant supervision and easy access. The valve gearing is mainly a simple eccentric. The same valve admits and cuts off steam, and its location is such that there are no long passages at each end of the cylinder to become filled with live steam. The exhaust valve is correspondingly located beneath the cylinder, has similar advantages, and through its situation frees the cylinder of water in a thorough manner

The form of the valves will readily be understood from Fig. 3 (see page 98), in which a valve is shown in section at A. The valves are circular slides, motion being imparted to them by levers keyed to valve stems. These stems have a flat blade of the length of the valve in the steam chest, and the valves oscillate on centers or fixed bearings in the front or back bonnets. In their adjustment, an important improvement has been made, to which we shall allude further on

The general arrangement of the governing mechanism is such that the quick opening and closing of the valves at exactly the proper time is secured by positive devices. Of these last, the prominent feature is the combination of eccentric and wrist plate, the latter affording an increasing speed at the end of the throw of the eccentric to compensate for its slow motion, at that period, in opening the steam valve. At the same time, the steam valve at the opposite end of the cylinder commences to lap its port, also by the motion of the eccentric, but by a reverse or subtraction of speed, produced by the same wrist plate, which speed is constantly decreasing till the throw of the eccentric is completed. The rapid opening and slow closing of the exhaust

Continued on page 98.

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Contents.

(Illustrated articles are marked with an asterisk.)

THE SCIENTIFIC AMERICAN SUPPLEMENT.

Vol. II., No. 33.

For the Week ending August 12, 1876.

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MODERN ROWING RACES.

Our aquatic sports seem to be assuming an artificial nature which is rendering them more and more unlike those of an earlier and less "advanced" period. Rowing races certainly have become reduced to competitions in which the conditions imposed by Nature, which give zest to the exercise and, through their very variety, constantly call forth fresh skill, are carefully eliminated. There is no sport more exhilarating, more healthful, or more reliable in results than this, when genuinely followed; but as it is now practised it is scarcely possible to place it on a level with the sports of the turf. It is an undeniable fact that horse racing has resulted in vast improvements in the breed of horses, and thus a genuine good is gained, which at least neutralizes the evils attending the practice. But we doubt if any corresponding advantage can be shown in favor of modern struggles at the oar.

We have learned to build boats so light and fragile that almost the rope dancer's skill is required to maintain one's equilibrium in them. They are utterly useless save in water as smooth as glass. The oarsmen are educated to so fine a pitch of physical culture that exhausted Nature too often passes the dividing line, and the superb athlete breaks down and becomes a life-long invalid. In fine, boat, water, oars, training, conditions of wind and weather, everything attending the sport, are all subservient to the single aim of disposing men so that by muscular work they can accomplish a certain distance in a certain time. So far as boat and water play any part, a result equally useful would be reached did the crews, instead of risking their lives under a torrid sun, seat themselves comfortably in a gymnasium and pull in concert against machines which would register the mechanical effect of their efforts in foot pounds, the crew with the largest registered number to be declared the winners.

The reports of the recent regatta at Saratoga tell us that the Cornell men won by sheer force of strength. They showed no technical excellence in their rowing; their appearance was not especially graceful; they lacked what is technically called form; but they lifted their boat, as it were, by main strength, and pushed it forward with the power and endurance of giants.

We do not think that such work is entitled to the name of skillful boating; and certainly, in point of heroism, it must be considered inferior to that ability which guides the lifeboat through the surf to the wreck, or pulls against varying tides and currents, or urges the sharp bowed whale boat in pursuit of the sea monster, or even handles the oar in a high running sea. To our minds, races occurring, not in hot July but in cool October, and not in mere shells on a placid lake, but in staunch cutters in a sea and tide way, would be infinitely more beneficial to the participants, and at the same time would call for the display of higher qualities, both of physical strength and calm judgment.

OUR YACHTS AND YACHTING.

There are abundant criticisms which may justly be urged against our present so-called yachting. Our yacht fleets are supposed to be a nursery of marine architecture, a constant field for experimentation in the construction of sailing craft of the finest possible form. The building of yachts is presumed to have higher aims than the mere furnishing of pleasure boats. We have, it is true, produced many beautiful models, famous the world over, but some of the best judges of naval architecture assert that we have never surpassed the celebrated America, built by Steers nearly a quarter of a century ago. That vessel has recently been in dry dock refitting, and certainly it is difficult to imagine more exquisite lines than her under-water body presents. We cannot therefore claim any material advance in the hull architecture; nor can we assert that we have built vessels with improved seagoing qualities. The America crossed the ocean years ago to sail for the Queen's cup. A few yachts have done so since, but the pleasure vessels rarely go to sea during a stormy season of the year. Yet pilot boats even smaller in size constantly cruise hundreds of miles from land in midwinter, and in the fiercest gales; and Long Island and New England fishermen unhesitatingly put to sea in storms which would send every yacht close-reefed into the nearest harbor. Nor has our yacht squadron shown itself of value as a school for seamen. The wretched incompetence exhibited in the circumstances attending the disastrous capsizing of the Mohawk, the largest sailing yacht in the country, in New York harbor a few days ago, is too fresh in the public mind to need any commenting upon in this regard.

So far as competition goes, the yacht race has become a matter of speed, no matter how gained. We have seen repeated instances of vessels fitted with sails so largely out of proportion to the hulls that a moderate breeze would be very liable to throw the latter on their beam ends. But to counteract the enormous heeling tendency, racing crews of unusual numbers are brought on board, and each man is provided with a sand bag. He is simply living ballast, and his duty is to transport himself and sandbag as far to windward as he can get. The pressure on the sails is met, not by build, nor by displacement, by breadth of shoulder, but by weight of men and sand bags. Not long ago a catamaran (two parallel hulls covered by a transverse staging and rigged with mast and sails) fairly vanquished a number of crack yachts. The yacht owners loudly protested against being conquered by so outlandish a craft, forgetting the fact that the ingenious builder merely gained stability by a device substantially the same and very much more effective, though of course more obvious, than theirs. Certainly the means he adopted were not a whit more artificial.

The Rev. Dr. Hepworth, of this city, an enthusiastic yachtsman, has, since the above was written, published a work in which our yachting is mercilessly criticized. He says of the yachts: "They have generally very graceful lines, great breadth of beam, which makes them roomy and comfortable under deck, but are often so overloaded with spars and canvas that they are unfit for rough outside work. Our topmasts run up to such an incredible hight that, when the boat begins to roll in a seaway, it seems as though she would never stop until she had jerked out her spars.

"The crowning defect, and one which we are beginning to acknowledge, is the shape of the bows. They are so sharp that they not only cut through the water when it is smooth, but they also cut into it and under it when there is any seaway on. The only thing that holds the head of a yacht up in rough weather is its preposterous bowsprit and jib-boom. We crawl along inshore and run for a harbor when the wind blows a reefing breeze. The play of a coaster or lumberman is the agony of a yacht."

In this country, where a large standing navy no less than an army is deemed unnecessary, it follows that not only the military but the marine service must in time of need be derived from the people. Our geographical position moreover renders it likely that a war between ourselves and a foreign power would mainly be waged afloat. An advantage to the community therefore primarily exists in fostering aquatic skill, while there are other advantages, sufficiently indicated above, which also might be secured. In this view the present condition of our aquatic sports is plainly one which might greatly be modified to the general benefit.

THE VENTILATION OF RAILWAY CARS.

Scarcely less important than the long-vexed and almost hopelessly unsolved problem of securing good air in public assembly rooms is the proper ventilation of public conveyances. Under no other conditions are we packed so numerously in limited spaces; and as a rule our journeys are of longer duration than the times we spend in places of public amusement, instruction, or worship.

The problem, so far as it relates to railway cars, was discussed at considerable length at the recent convention of the Master Car Builder's Association. Neither the committee's report nor the subsequent remarks of the members of the association give much cause, however, for expecting any immediate relief from the poisonous atmosphere the traveling public has to put up with as a rule. The important fact that pure air is desirable in public conveyances is recognized in a languid sort of way; but, so the committee say: "The subject (of securing it) is still practically encumbered with difficulties, and our only hope is that, by treating it piecemeal, the difficulties may one by one be overcome." The past year has been "quite barren" of improvement in ventilating devices, still an increasing interest in the matter among car builders shows that "some progress is being made in the right direction."

But two or three recent devices were noticed by the association, and of these nothing positive was determined. Mr. Daniel S. Darling, of Brooklyn, submitted the model of a ventilated car, by which he claimed to meet all the requirements of the case. By this plan the fresh air is taken in through an opening at the crown in the ends of the car, immediately under the roof, the opening to be regulated according to the speed of the train and the quantity of air desired. The inflowing air is received in an air chamber and delivered through side openings a quarter of an inch wide, extending the whole length of the car. With an inlet 12 inches by 6, and a speed of 20 miles an hour, a steady supply of 800 cubic feet of fresh air a minute is promised, or enough to effect an entire change of air in the car every three minutes. No attempt appears to be made in this plan to prevent the entrance of smoke and dust; while the current, entering the body of the car in sheets, would seem to be specially favorable to drafts, though the inventor is of opinion that in a car ventilated in this way the fresh air will be diffused very gently.

Mr. H. A. Gouge, of New York, also presented a model illustrating some improvements on his mode of car ventilation. This plan has been tried the past year in a car running on the Boston and Albany road, giving, it was reported, very good satisfaction in warm weather. In cold weather the warming of the car was defective, especially on an accommodation train; but that difficulty Mr. Gouge was confident he could overcome. Another car on the same road was provided with a fan ventilator, with excellent results in warm weather and with a moderate rate of speed; but it was very difficult to heat the air sufficiently in cold weather, and the air was rather close when the car was not in motion.

Still another plan was tried on the same road, the management of which seems to be commendably in earnest in this matter: a plan devised by Mr. Gates, of Boston. It consists in lowering the head lining a few inches so as to make an air chamber between it and the roof, from which chamber the fresh air enters the body of the car through wire cloth or perforations extending the entire length of the car. The entrance and exit of the air is regulated by swing sashes at each end of the car. So far the plan seems to work well, but a longer trial must be made before a decided opinion can be expressed in regard to its merits. A similar device is on trial on the Pennsylvania Road.

Favorable report was also made of the Winchell ventilator, with which certain western roads have been experimenting. The Canada Southern has had it, without deflectors, on four cars, and the representative of the road pronounced its operation very satisfactory. A little smoke got in, but not enough to be troublesome. The system consists

in an air chamber in the roof, extended into a hood covered with very fine wire gauze, and carrying in the end a wicket opened and closed by a rod. In the bottom of the chamber is a register through which the air is forced down the center aisle of the car. The rear gate acts as an exhaust. So far the plan resembles Mr Gates'. For summer use, when the windows have to be open, the rear gate is closed, and deflectors are used to prevent any inrush of smoke or dust at the windows, and to serve as an exhaust. The chief objection seems to be that it is costly, and the air is not warmed.

Evidently there is a good field here for our inventors to cultivate, one likely to be profitable to them and very beneficial to the traveling public.

TIMELY KEROSENE DANGERS.

While the mercury remains in the nineties and occasionally rises above 100°, it will be a prudential measure to keep a sharp watch on any kerosene oil that is being used. There are large numbers of rascally or ignorant dealers who sell a compound containing gasoline and other light products which will readily flash at 100° and often at 90°. As it is the gas or vapor from the oil that explodes, it is hardly necessary to point out the danger of keeping a material in the house which, during the intense heats of summer, will reach a state when such explosive gas is freely evolved.

Public attention may also here be called to the peril incurred in using kerosene on traveling conveyances. We notice that in several instances it is being used on railway cars in place of the safe candle; and on steamboats where coal gas is not employed, it is the only mode of illumination. It is curious to remark that for marine purposes the thoroughly reliable sperm oil is gradually becoming obsolete; and that even for vessels' side lights, where certainty of continuous illumination is the prime necessity, kerosene is being used. Sperm oil is actually difficult to obtain in this city, even in comparatively small quantities.

Of course, in the confined limits of vessels and railway cars, the perils from kerosene are greatly augmented; and where inspections by government officials, as in the case of steamboats, may carefully be made, we think that such should include a most rigid investigation into the kind and nature of oil employed. There are, of course, certain kinds of kerosene in the market practically as safe as sperm oil; but on the other hand, the poorer and more dangerous grades are cheaper, and hence are used both through ignorance and cupidity. The steamboat law is extremely explicit on the subject of explosive compounds, and it covers all cases, whether the material is barreled for freight, or innocently contained in the cabin chandelier. It distinctly states that "no products of petroleum shall be used on any steam vessel for illuminating purposes that will ignite at a lower temperature than 150° Fah." The penalty for carrying dangerous explosives is $5,000 fine, or three years' imprisonment, or both. The law is certainly stringent enough, and it remains for the authorities to enforce it, otherwise some frightful conflagration aboard a steamboat may be the result of their neglect.

We mention steamboats more especially because at this season of the year they are almost always crowded, and an accident, even through panic alone, may easily assume very serious proportions. Kerosene, we think, has no place on railway cars; it does not give an adequate light for reading at night, nor is it in any respect, save, perhaps, in point of expense, an advantage over the time-honored candle. In case of a collision or overturn of the cars, the breakage of the lamps and spilling of the oil have often produced a fire and a panic, and will so again if the companies persist in allowing its use.

THE THUNDERER BOILER EXPLOSION.

The double-turreted English ironclad Thunderer was recently the scene of a terrible boiler explosion. The vessel was built some three years ago but, had never been fitted for sea nor had her machinery tested. She had eight boilers of the common low pressure type, which supplied steam to twenty-six small engines for performing various work, besides to the main propelling engines, of 800 horse power. An official trial having been ordered, on the measured mile, near Spithead, steam was got up. The safety valves were supposed to be loaded to blow off at 30 lbs., and a large force of experienced firemen were employed under the Chief Inspector of Machinery. Fires had not long been started when a loud, sharp explosion, exactly resembling the report of a 38-tun gun, was heard, and vast clouds of steam poured up from below. The destruction was terrible. The men in proximity to the boiler were torn to pieces, while others, cooped up in the after-hole, were literally boiled to death. Fifteen persons, including the chief engineer, were killed instantly, and fifty-six were wounded. The end of the forward boiler on the starboard side was blown completely out, the uptake and main steam pipe were hurled bodily away, and the after fire room, generally, was a ruin.

It was supposed (and in the detailed accounts of the disaster which have reached us by mail, it is so stated) that a deterioration had taken place in the boilers, rendering them weak, owing to the lapse of time intervening between their reception from the contractors and the special trial. A telegraphic despatch, however, coming before the mail, reported the result of the official investigation, and the accident appears to have been due to the most inexcusable negligence. Previous to the steam trial, the boilers had been tested by hydraulic pressure, and, of course, all the safety and other relief valves were tightly fastened down by steel wedges. The wedges were forgotten. The pressure soon exceeded the strength of the plates, and the explosion was a necessary consequence. Those watching the steam gage must have seen its rapid ascent; and certainly it seems impossible that they could have failed to remark that the safety valve was not lifting after the 30 lbs. set pressure had been attained, and to have taken measures promptly to discover the cause; but the most cautious of men, on the other hand, cannot reasonably be expected to foresee and guard against the consequences of such inconceivable blundering as here appears to have been the case. This is the third serious disaster which has occurred to the English ironclads within a year, the previous casualties, the sinking of the Vanguard and the collision of the Iron Duke, being due to negligence but little less culpable.

THE CENTENNIAL EXPOSITION.

As the days have grown cooler, the attendance at the Centennial already shows gratifying signs of increase. Excursion parties, wisely postponed until the conclusion of the hot weather, are now arriving in rapid succession. Whole militia regiments from this city, college students by the hundred, miners of the Reading Coal and Iron Company by the thousand, bands of workmen from factories, besides the throngs of individual visitors, fill the buildings to an extent which is suggestive of the crowding which must take place when the September rush begins. The Granger excursions, and the farmers generally, are waiting to gather the harvests, and also for the great agricultural display of live stock, etc., to open later in the season. From present indications we think that those who contemplate a careful study of the Exposition will do well to make their visits now rather than risk later the annoyances which must follow the presence of a great crowd. If the interest which the people are taking in the show on one hand, and the comparatively small attendance during the past few weeks, are any criterions, the estimates made of the throngs which will pack the buildings in September and October are more likely to be exceeded than otherwise. Every department is now in perfect order, and the most elaborate of examinations can be comfortably and leisurely made.

Preparations for the live stock show, to be open from September 21 to October 4, are being rapidly advanced. A new entry is announced, which will be of the greatest interest to our stock raisers, in the shape of a drove of 100 of the choicest English cattle from the flocks and herds of Lords Chesham and Walsingham, the Royal Agricultural School, and others. The show of sporting dogs, to be held on September 4, 5, 6, 7, 8, also will be very attractive, a superb collection being expected from the celebrated English kennels. A large number of valuable prizes have been offered by private parties for the finest animals of various breeds. The American Forestry Association are to meet on the grounds early in September, and probably some useful suggestions will be forthcoming relative to the preservation and protection of forest trees.

THE ENGLISH COLONIES.

Four of the five Australian colonies, Victoria, New South Wales, South Australia, and Queensland, are represented at the Exposition. The fifth colony, West Australia, a penal settlement of scanty population, sends nothing. The vast gold production of Australia and New Zealand is represented by a tablet which faces the visitor at the entrance of the Victorian section. This gives statistical figures showing that, since 1851, the colonies have produced $1,220,823,034, a vast sum which affords an idea of the great *rôle* which the precious metal has played in the development of these young and vigorous provinces. An excellent feature of the Victorian exhibit is a collection of photographs grouped in frames of uniform size, illustrating the scenery, towns, and principal buildings in each of the shires into which the colony is divided. The most striking landscapes are presented in large oil paintings. Wheat, barley, oats, and wool, the last in fleeces of remarkable size, are the principal agricultural products exhibited. There are, besides, a fine collection of minerals, cases of stuffed birds and animals, shelves of ales and wine, cordage, stone ware, and food preparations of all kinds.

The adjoining section is that of South Australia, the agricultural resources of which are better than those of any other colony, although the mining interests are very small. The southern portion is claimed to be the finest wheat-growing country in the world. No less than 112 varieties of wine are shown. A series of photographs represents the rural life of the colonists, and the same graphic means is resorted to to show how a telegraph line was constructed across the island. The most curious exhibit in the section consists in the novel and beautiful objects made of the eggs of the emu. These are as large as ostrich eggs, and have a dark green surface resembling granulated morocco leather. They are superbly mounted in silver. One of the most elaborate pieces represents the egg (which opens and forms a casket) as a rock on a hill overshadowed by a peculiar indigenous tree. On the slopes of the hill groups of natives, in oxidized silver, are seen hunting emus and kangaroos. Another shows a group of gold miners at work, in the egg, and a lively encounter between natives armed with spears and clubs is going on outside in the midst of singular vegetable growths.

The New South Wales court is larger than that of either of the other colonies. A mineral trophy contributed by the Government Department of Mining is, after the great yellow column representing the gold production, the most prominent object. It consists of four large buttresses of coal from different mines, and of specimens of iron, lead, tin, copper, and auriferous ores. There is also a fine collection of tin ore specimens. Among the many photographs is one, a view of Sydney Harbor, which measures five feet by three feet four inches. This was printed from a negative of similar size, and one of the largest in the world. A pyramid of wine bottles, it is said, contains over 100 kinds of wine. There is a small collection of peculiar birds, among them being the "settler's clock" (*dacelo gigantica*) that salutes the rising sun with a sound resembling a laugh, and the Herodias crane that carries, attached to the middle of its back, a number of long skeleton feathers which it can erect at pleasure. Kangaroo leather, used for boot tops, is displayed in abundance, besides excellent exhibits of wool, woolen fabrics, and native woods.

Queensland divides her wall space into black panels, in which are descriptions and statistics of the different parts of the country. Near the appropriate tablets are landscapes, and also specimens of products of the various sections. A gold pyramid, and exhibits of wines, wools, oils, etc., fill the center of the court.

New Zealand exhibits bituminous coal from sixteen different seams, a pyramid of gold, a fine collection of ores and samples of crude petroleum too heavy for anything but lubricating purposes. A singular substance is the Kauri gum, a vegetable deposit found about six feet below the surface of the ground, in lumps of all shapes and sizes. It is supposed to have been distilled by Nature from a species of conifer. It is worth $200 a tun in New Zealand for making varnish. There are also some good specimens of the *phormium tenax* or New Zealand flax, worked into ropes and mats, and an interesting collection of garments, weapons, etc., of the Maoris, besides industrial products of all kinds.

Tasmania shows principally wool, wheat, and the dressed furs of a number of singular animals found only in the Australian group, including the platypus, kangaroo, wirubut, bandicoot, and the Tasmanian devil. There is a curious jelly for table use among the food productions, made of seaweed, and a photograph of the last aboriginal Tasmanian, the sole member of a race supposed by Haeckel to be nearest of all to our alleged monkey ancestors.

Ceylon sends coffee, nutmegs, tapioca, pepper, gums, and gamboge, all raw products. Singapore sends a similar display, with the addition of some plumbago, and an elephant carved in that material by a native. Mauritius displays samples of arrowroot, sugar, medicinal plants, and a collection of ethnological types. The Archipelago of Seychelles, a dependency of Mauritius, sends sixty-seven varieties of woods, besides cocoa, cloves, and coffee.

The Cape of Good Hope covers the inside of the allotted section with skins of wild animals and elephants' tusks, and crowds the space inside with ostrich plumes, dried plants, wools, etc. There are some curious necklaces and bracelets of melon seeds and steel beads, ostrich eggs converted into cups and card baskets, and a model of a leviathan incubator, flanked by two ostrich chicks as specimens of its work. The Gold Coast colony exhibits curiously artistic gold ornaments and wood carvings, the work of natives.

Jamacai, West Indies, displays nuts, barks, spices, rum, arrowroot, and yam flour, breadfruit meal, cassava starch, coffee grown at 5,000 feet above the sea level, said to be the finest in the world; beautiful fancy articles made from a lace bark of the lagetta tree, and artificial flowers, looking like wax work, but formed from the cuticle of the leaf of the *Yucca alvifolia*. The Bahama Islands send exquisite wreaths and sprays made from little pearly white shells, baskets made of mimosa beans, and specimens of tortoise shells, sponges, etc. Bermuda contributes corals, palm leaf fans, cups and boxes of cedar, and a model of the great floating dock, besides sending frequent shipments of vegetables to Agricultural Hall. From Trinidad we have fifty-seven samples of native woods, crude gutta percha, Angostura bitters, crude asphalt from the great Pitch Lake, and various vegetable fibers adapted for cordage. Guiana sends samples of sugar and rum.

This completes the list of the productions of the English colonies: a display which for completeness and instructive value is, as a whole, one of the finest in the great Fair.

Progress of the Railway Tunnel under the Hudson River, New York city.

In April, 1875, we gave the details and drawings of the Hudson River Tunnel, projected by Mr. D. C. Haskin, of this city, and designed to establish direct railway communication between New York city and Jersey city. The work was begun by commencing a vertical shaft of brick masonry, 30 feet in diameter and 4 feet thick, at the junction of Jersey avenue and 15th street, on the New Jersey side, between the present depots of the Erie and Delaware and Lackawanna railways. After the shaft had reached a depth of about 20 feet, the Delaware and Lackawanna Company commenced legal proceedings to stop the work, obtained injunctions, etc., and, by resort to various legal quibbles, managed to delay the enterprise until the present time. The Hudson River Tunnel Company has, however, come off finally victorious, the injunctions are removed, and the construction is now to be proceeded with. It is understood that the wealthy Senator Jones, of Nevada, furnishes the capital, the estimated cost being ten to fifteen millions of dollars. The shaft on the Jersey side is to be carried down 65 feet. The horizontal tunnel under the river will then be commenced. The latter is to be 26 feet in diameter.

A NEW TEST COLOR.—The flowers of the violet and iris have recently been found to yield a very fine blue color, which is a more delicate test for acids and alkalies than the solution of litmus commonly employed. The name of the new color is phyllocyanin. It will probably before long find its way into all chemical laboratories.

(Continued from first page).

ports are also obtained by the same eccentric and wrist plate, but with greater rapidity, as the travel is greater on the opening of the exhaust.

The constant variations of load upon the engine are communicated to the steam valves instantly by the governor. The latter is extremely sensitive, and in reality performs very slight labor, since it puts forth only the force necessary to move a small stop, and indicates merely the change required, to the levers which move the valves. There is an ingenious stop motion provided, which, should the regulator become inoperative through any cause, effectually prevents the engine running away. The mechanism is such that the steam valves are then not allowed to hook on, and therefore they cannot open. Consequently the engine is stopped by this mechanism alone, although the screw valve may be wide open.

The principal improvement to which it is the object of the present article to direct the reader's attention, as has already been noted, is found in the means of packing the valve stems so as to obviate the stuffing boxes, while at the same time rendering them self-packing. Hitherto, in order to prevent the grinding of the cast iron faces of the valve and bonnet, a collar has been placed out on the valve stem so as to bear against a heavy cast iron bracket or bonnet secured to the side of the cylinder. This counteracted the thrust on the valve stem—if we may use the term—due to the steam pressure within, which otherwise would force the faces mentioned together, cause wear, and speedily render the mechanism untrue. In addition to this collar, the usual gland and stuffing box for the valve stem were required. Apart from there being here a multiplicity of parts, which it would be a great advantage to simplify, the casting, of course, had to be painted, and the paint in time would, by the heat, become cracked and worn; while the lubrication of the stem, with consequent unsightly dripping, aided in rendering the whole contrivance one for which a neater and better arrangement might well be sought.

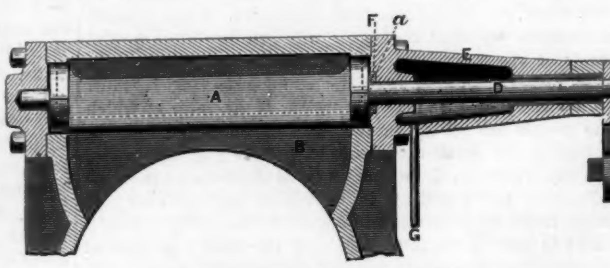


Fig. 3.—THE HARRIS-CORLISS STEAM ENGINE.

The new device which has lately been substituted (but which has now been tested by the manufacturer for nearly four years), and a sectional view of which is given in Fig. 3, seems to remove all difficulties. It obviates the stuffing box completely, and shifts the thrust collar from the outside to the inside of the cylinder, and, abolishing the extra cast iron bracket, causes the collar to bear directly against the bonnet, D is the valve stem on which is shrunk the steel collar, F, which, as shown, fits in a recess, *a*, of the bonnet. The opposing faces are finely scraped in manner similar to planer slides or lathe ways. Consequently they approximate very closely, and are packed by the steam itself acting outward on an area equal to the section of the valve stem, D. It will be seen at once that the joint is self-packed, while its chances of wear are exceedingly small, certainly very minute in comparison to what might be the case with cast iron surfaces, perhaps 8 inches in diameter, under other arrangements. The bonnet, E, now becomes a finely polished casting, rendered light by the hollow chamber within. Into this space all drip enters, and is carried off by the pipes, G, which, as shown in the large engraving, extend from bonnet to bonnet, so as to keep all clear and empty.

The other improvement which may be noted is not represented in the engravings. It is, however, a novel piston packing, devised by Messrs. Babbitt and Harris, and which has been in practical use by them for some four years and a half. Its efficiency will be understood from the fact that single-acting engines, in the cylinders of which it has been applied, have frequently run for an entire day at a time with the back cylinder head off, and this with no leakage past the piston. The general construction is simply a packing ring, in sections, inserted in a groove in a chunk ring, and held out, not by steam, but by spiral springs made of German silver. When steam is admitted into either end of the cylinder, the packing ring is carried by the steam over to the side of the groove in the chunk ring, making a joint there and allowing the steam to pass down by and under the packing ring. The latter is thus balanced, while a very light spring is able to exceed the action of gravity and hold the ring out. The packing is very easily taken out and put in, as it is all held in its place in the chunk ring by pins for that purpose, which are removed before putting on the follower. It is stated to be free from the defects of steam packing, and, with proper cylinder oil, not to require renewal for years. The engine is comely in all its proportions, as the engravings show, and finished in the best manner possible. It remains now to sum up briefly the advantages which are claimed for the machine, which claims seem, from its construction, to be well founded. They are economy of fuel, wear, oil, and all that relates to the production of power; an increased amount of work, regularity of speed under varying load and pressure, accessibility of all parts; no portion of the regulating medium acts through stuffing boxes nor enters the steam chest, nor is out of sight of the engineer; the cylinders are bored out of hard, strong iron; the shafts are made of hammered wrought iron, with ample bearings; the stop motion, as already explained, prevents running away; and the recessed valve seats prevent the possibility of shoulders wearing on them. Lastly, and we reserve it to the last because it is a point the value of which we have frequently urged upon engineers, the small parts of the engines are interchangeable; and therefore should accident occur, the injured portion can be speedily and accurately replaced from the manufactory. The manufacturer even keeps extra cylinders on hand to meet such emergencies, while, by the aid of special tools, he is enabled to construct the whole engine, from 10 to 1,000 horse power, in a manner both thorough and exact.

The machine is based entirely on the Corliss system, and was constructed under the same patents during their continuance. It therefore embodies the advantages of engines of that type, together with those secured by the improvements invented by its manufacturer.

The Harris-Corliss engine gained gold medals at the Cincinnati fairs of 1873, 1874, and 1875, and in the last-mentioned year an additional premium of $300 in gold. It is not exhibited in the Centennial Exposition, we are requested to state, on account of the inability of the manufacturer and the Centennial authorities to reach an arrangement satisfactory to the former. For further information, address the manufacturer, Mr. William A. Harris, Providence, Rhode Island.

Why is the Sea Salt?

Professor Chapman, of University College, Toronto, says that the object of the saltness of sea water is to regulate evaporation. If any temporary cause raises the amount of saline matter in the sea to more than its normal value, evaporation goes on more and more slowly. If the value be depreciated by the addition of fresh water in undue excess, the evaporating power is the more and more increased. He gives the results of various experiments in reference to evaporation on weighed quantities of ordinary rain water and water holding in solution 2·6 per cent of salt. The excess of loss of the rain water compared with the salt solution was, for the first twenty-four hours, 0·54 per cent, at the close of forty-eight hours, 1·46 per cent, and so on in an increasing ratio.

IMPROVED FOUNTAIN PEN.

The annexed engravings represent an ingenious little invention, well calculated to be of service to the large class of persons who constantly use the pen. It is a fountain attachment for pens of all kinds, easily attached and detached, and supplying a large quantity of ink without interfering with the elasticity of the pen. The disadvantage often met with in fountain pens, no one of which, of course, can be constructed to suit the requirements of all hands, is thus avoided, for the writer, after securing a pen that suits him, has only to apply the attachment.

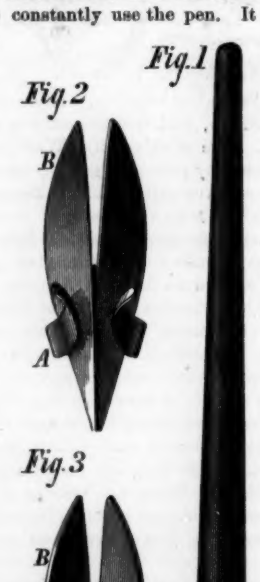


Fig. 1 of the engraving represents the device in full size and in place. Figs. 2 and 3 are, respectively, front and rear views enlarged. Fig. 4 is a transverse section. It is made of one piece of sheet metal having clasps, A, bent up from elongated wings, B, which last are separated by a slit and fitted to the concave inner side of the pen. Below the wing plates is the reservoir, C, whence the ink flows down to the point of the pen. The spring clasps firmly secure the device to the pen in the manner indicated in the sectional view.

The inventor states that the large quantity of ink taken up at one dipping is always under control, and that a clear sharp outline is left by the pen. The capillary attraction of the inner sides of the device is so great that the possibility of the ink dropping out, when inverted, is avoided, while the quantity of ink contained will last from 20 to 30 minutes. The attachment, being made of gold or silver, or heavily plated, is unaffected by the action of the ink, and will last indefinitely. Patented through the Scientific American Patent Agency, June 13, 1876. For further information, address the inventor, Mr. Henry H. Perkins, P. O. Box 585, Utica, N. Y.

To Preserve Flowers and Plants.

The following instructions are from the pen of Rev. G. Henslow, one of the best practical botanists in England.

The materials required are common cartridge paper, thick white blotting paper, cotton wadding, and millboard, all cut to the same size. The plants should be gathered in dry weather, and soon after the flowers open, when their colors are brightest. Succulent plants such as daffodil, orchis, or stone crop) should be put into scalding water, with the exception of the flowers, for a minute or two, then laid on a cloth to dry.

Arrange the specimens and papers in the following order: Millboard, cartridge paper, wadding (split open, and the glazed side placed next to the cartridge paper), blotting paper, the specimens, having small pieces of wadding placed within and around the flowers to draw off all the moisture as quickly as possible, blotting paper, wadding as before, cartridge paper, millboard. When the specimens, etc., are thus arranged heavy weights should be put on them; about 30 lbs. the first day, 60 lbs. afterwards. Remove them, from under pressure, in a day or two; carefully take away all the papers, etc., except the blotting papers between which the specimens are placed; put these in a warm air to dry, while the removed papers, etc., are dried in the sun, or by the fire. When dry (but not warm) place them in the same order as before; put all under the heavier pressure for a few days, when (if not succulent) they will be dry.

Flowers of different colors require different treatment to preserve their colors. Blue flowers must be dried with heat, either under a case of hot sand before a fire, with a hot iron, or in a cool oven. Red flowers are injured by heat; they require to be washed with muriatic acid, diluted in spirits of wine, to fix the color. One part of acid to three parts of spirit is about the proportion. The best brush with which to apply this mixture is the head of a thistle when in seed, as the acid destroys a hair pencil, and injures whatever it touches (except glass or china); therefore it should be used with great care. Many yellow flowers turn green even after they have remained yellow some weeks; they must therefore be dried repeatedly before the fire, and again after they are mounted on paper, and kept in a dry place. Purple flowers require as much care, or they soon turn a light brown. White flowers turn brown if handled or brushed before they are dried. Daisies, pansies, and some other flowers must not be removed from under pressure for two or three days, or the petals will curl up. As all dried plants (ferns excepted) are liable to be infested by minute insects, a small quantity of the poison corrosive sublimate, dissolved in spirits of wine, should be added to the paste, which it will also preserve from mold. The best cement for fixing the specimens on to the paper or cardboard is gum paste. It is composed of thick gum water and flour mixed in warm water, by adding the two together, warm, and of a consistence that will run off the hair pencil.

Tree Frog Eggs.

Professor Peters has lately described the mode of deposit of its eggs employed by a species of tree frog (*polypedates*) from tropical Western Africa. This species deposits its eggs, as is usual among batrachians, in a mass of albuminous jelly; but instead of placing this in the water, it attaches it to the leaves of trees which border the shore and overhang a water hole or pond. Here the albumen speedily dries, forming a horny or glazed coating of the leaf, enclosing the unimpregnated eggs in a strong envelope. Upon the advent of the rainy season, the albumen is softened, and with the eggs is washed into the pool below, now filled with water. Here the male frog finds the masses, and occupies himself with their impregnation.

Aerolite in Kentucky.

The Louisville *Courier-Journal* states that on July 18, at 4 A.M., Mr. White, watchman of the Weatherford engine house, while on duty, was startled by a loud report like that of a pistol, and instantly following some heavy substance fell into the street a few feet distant. Mr. White searched, and found imbedded in the ground a stone, of the appearance of dark flint, weighing about two pounds. The stone was broken to pieces and examined during the day by several scientific gentlemen, who pronounced it genuine meteoric substance. The probable solution is that the explosion occurred at a greater distance than was supposed, and that this was but a small fragment of a large aerolite.

MEDIÆVAL IRON WORK.

Some of the most interesting relics of the middle ages are to be found in the specimens of metal work which adorn many old mansions in Europe. It is astonishing to see the beauty of proportion and detail, the adaptation of the object to its purpose, and the elaboration of the work, and then to reflect that the whole design was the creation of the smith who performed the labor, who thought out the graceful form at the time he wielded the hammer. Schools of art, so called, there were none in those days; but every workman received, unconsciously, an art education. In Germany, especially, the apprentice traveled from place to place, learning the art, and improving his mind as he went. He saw the church of St. Sebald, in Nuremberg, with its shrine or tomb, on which Peter Vischer and his five sons labored 13 years; he saw the wonderous cathedral of Munich, the Church of the Apostles at Cologne, and the wonderful gothic minster at Antwerp. And in nearly every city he visited, he found articles of every day use fashioned with rare skill and pure taste; and so he acquired the art of construction and ornamentation at the same time, and learnt that use and beauty are, in all true art, inseparable.

We illustrate herewith a wrought iron window grille or lattice, made in the sixteenth century and now to be seen in a house at Ratisbon in Bavaria, a city which can boast numerous works of art industry from the hands of mediæval artists. The design is remarkably graceful, and the elaborate workmanship shows skill in handicraft of the very highest order.

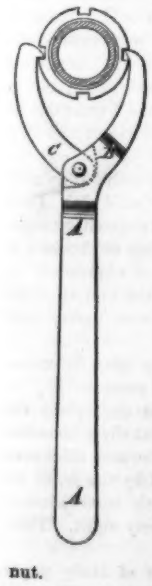
WINDOW GRILL AT RATISBON, BAVARIA.

Rheumatism.

The *Journal des Connaissances Médicales* contains a review of certain curious observations made by Dr. G. Esbach on the conformation of the fingers in various diseases. In persons that perspire easily, or in the case of disorders that induce profuse perspiration, such as rheumatism, typhus fever, etc., the transversal curvature of the nail is increased to exaggeration. This symptom, which scarcely ever fails to present itself in rheumatic subjects, has led Dr. Esbach to establish, by a statistical method, the sudoral etiology of that affection, and in the immense majority of cases he has found the following result: A man who perspires easily, and who inhabits a ground floor, becomes, sooner or later, rheumatic; if, on the contrary, he lives in a dry apartment, he is never troubled with that malady. On the other hand, a man who is not subject to perspiration may live in a damp room with impunity. Rheumatism appears thus to be placed on its real ground; dampness may be the cause of it, but only in such habits as perspire freely.

IMPROVED SPANNER WRENCH.

Mr. A. Frank Skinner, of Plattsmouth, Neb., has patented (March 30, 1876) through the Scientific American Patent Agency, a novel improvement in spanner wrenches, which we illustrate herewith.



It consists in providing a nut wrench with two equal arms, of which the rigid one has a pushing point slightly curved, while the pivoted arm has a drag hook on on its end.

A is the handle of the wrench, the forward part of which is curved outward and forward, and is pointed to form the rigid jaw, B, the said jaw and handle being thus formed in one piece. C is the movable jaw, upon the outer end of which is formed a hook, and its inner end is inserted and pivoted in a socket formed in the angle at the intersection of the jaw, B, and handle, A, as shown in the figure. In forming the wrench the handle, A, and jaw, B, are forged in one solid piece, and an eye or socket is punched in it to receive the loose jaw, C, which is then formed and pivoted in the said eye or socket. In this way a very convenient and effective instrument is produced, having great strength and power, and adapted to fit any spanner nut.

A New Way of Allaying Dust.

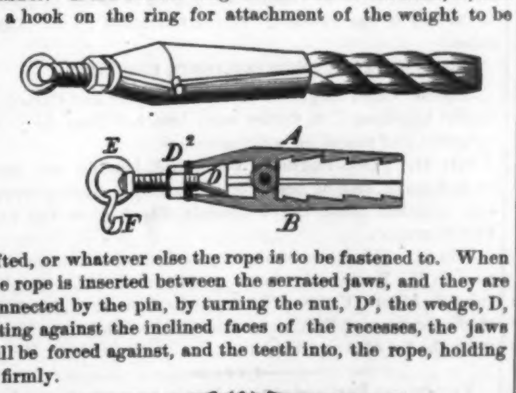
Mr. A. Houzeau has recently suggested to the French Academy of Sciences a mode of preventing dust on roads, etc., which, if experience demonstrates its practicability, will be found both simple and useful. He proposes simply to mix with the water, wherewith the thoroughfares are sprinkled, a small quantity (amount not stated) of chloride of calcium. This, he thinks, will form a patina or crust of considerable resisting power, which will last for several days and which will hinder both the drying of the soil and its disintegration by vehicles, etc. At the same time it will prevent the growth of weeds, and thus, on private roads and walks, prove labor-saving. A similar application of salts in solution was made in London three years ago, with complete success.

Vegetable Leather.

A new utilization of sea weed is suggested in the manufacture of a fabric named as above. Sheets of carded wadding are placed on hot polished metal plates, and coated with a concentrated decoction of sea weed, lichen, pearl moss, or other mucilaginous vegetation. The sheet is then dried quickly, thus giving to the surface applied to the metal plate a gloss like that of leather. Rolling and compressing between heated cylinders follows, and then a coating of boiled linseed oil is applied. Afterwards a thin coating of vegetable wax is given, and another rolling to soften the sheet finishes its preparation, when it is ready for bronzing, or any other treatment.

A SIMPLE ROPE CLAMP.

A simple clamp, by which a rope's end may be tightly secured, was patented January 4, 1876, by Mr. Levi H. Page, of Chicago, Ill. The clamping jaws, as shown in the engravings, are formed by two semi-tubes, A and B, made with teeth on their inner faces to hold the rope and prevent its slipping out. A pin, C, passes through lugs on each to form a hinge joint. This pin may be removed to attach the end of the rope by placing it on one jaw, when the other is laid upon it and the pin inserted. An inclined groove is cut in the solid ends of the clamping jaws, above the hinge, to receive a wedge, D, which is formed on the edge of the spirally threaded stem, on which is a nut, resting against a washer. E is a swivel ring on the end of the stem, D, and F a hook on the ring for attachment of the weight to be



lifted, or whatever else the rope is to be fastened to. When the rope is inserted between the serrated jaws, and they are connected by the pin, by turning the nut, D^2, the wedge, D, acting against the inclined faces of the recesses, the jaws will be forced against, and the teeth into, the rope, holding it firmly.

THE weight per yard of cast iron pipe in lbs. is found by subtracting, from the square of the outside diameter in inches, the square of the inside diameter in inches, and multiplying the remainder by 7·35.

The Great Suspension Bridge over the East River, between New York and Brooklyn.

The towers and anchorages of the East River bridge are now about completed, and the work of constructing the bridge proper will shortly begin.

The plan of operations, as given by the engineer, is as follows: A steel rope, three fourths of an inch in diameter, will be temporarily fastened to the New York anchorage, thence conveyed over the top of the tower and the coil conveyed to Brooklyn by means of a scow. The rope will then be passed over the Brooklyn tower and to the anchorage, but will be left slack and under water until late at night or early in the morning, when few vessels are passing, when it will be pulled taut. This steel rope will be also temporarily secured to the Brooklyn anchorage and the coil borne back to New York by the scow, and the ends connected, thus forming an endless rope, working on pulleys at each anchorage and on each tower, and worked by machinery on the Brooklyn side. By means of this endless rope other similar ones will be put up as required for the further construction of the bridge. First, two steel wire ropes, 2¼ inches in diameter, will be carried across and made secure to temporary fastenings at each anchorage. These will be 3½ feet apart, and placed a little to the south of the middle of the tower, running over the top. They will be used for the construction of a temporary bridge for the use of the workmen. Oak planks, 1½ inches in thickness, will be laid upon the ropes, with spaces of about half an inch, both for the purposes of economizing material and to lessen the effect of the wind upon it. They will be fastened by strips running lengthwise across the ends, which will be bolted to the ropes by U-shaped clamps.

The bridge will be completed by stretching small ropes on each side about 3 feet above the flooring and secured to every ten feet. It will be rendered firm by guys.

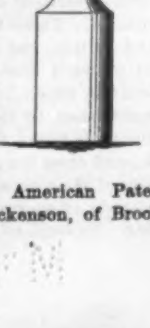
Three other steel ropes, of the same magnitude as those used in the construction of the foot bridge, will be stretched across the river over the tops of the towers—one 27 feet south of the foot bridge at the edges of the piers, one over the north edges, and one midway between the north rope and the foot bridge, with a space between the north and south ropes of 81 feet. The object of these last-mentioned ropes is to support small cross bridges, technically called cradles, and necessary for the construction of the other portions of the bridge.

There will be five of these cradles, one in each land span between each tower and its anchorage, and three at equal distances in the river span. They will project 10 feet beyond the outside cable, and will support pulleys for the endless ropes. The whole temporary structure will be 200 feet above high water at its center and lowest point, so that no water craft will be interrupted by it. After this work is completed, the construction of the bridge proper will be proceeded with, and the first step will be the stretching of the main cables, which will be put up at the same elevation as the temporary bridge and lowered. These cables will be composed of nineteen strands, each strand being made up of 330 wires, No. 7 gage—that is a little more than ⅛ of an inch in diameter. The material used will be the best quality of steel wire. The ropes of the temporary bridge will not be taken down, but finally incorporated into the superstructure of the bridge.

A NEW INSECT POWDER GUN.

This is one of those simple little devices which frequently prove very remunerative to the inventor. It is a substitute for the numerous more costly syringes, bulbs, and spring powder ejectors, now employed for throwing insecticide powder into crevices of furniture, etc.

It is simply an elongated rubber bulb or nipple, the forward part of which is tapered to a point, and is curved to one side, as shown. The other end of the bulb is open, is inclined, and has a collar formed upon it. By this inclination of the collar, when the rubber is applied to the neck of a bottle and is held in a horizontal position, a quantity of the powder will rest in the belly of the bulb, and can be projected upward by compressing the said bulb.



The device may be made with its pointed end closed so that it may be applied to the neck of a bottle containing the powder, and sold with said bottle. In this case the buyer cuts off the point of the bulb with a pair of shears. It was patented through the Scientific American Patent Agency (May 30, 1876) by Mr. C. B. Dickenson, of Brooklyn, N. Y.

[For the Scientific American.]

EFFECTS OF TIDE CURRENTS ON HARBORS.

The effects of running water are very strikingly perceptible on the banks of rapidly flowing rivers. The channels of the Missouri and Mississippi rivers are continually changing; and the griefs of shipowners and captains, and the shrewd devices of pilots on this account, have been most attractively depicted by Mark Twain. Many a time has a planter retired, with his home and plantation on one side of the river, and awakened in the morning to find that the river had cut a new channel on the other side of his property. The crescent-shaped bayous so common along the south Mississippi, are results of this change of river bed by washing across from one curve to another in a straight line, instead of following the direction of the bend. The work of Captain Eads, now in progress at the mouth of the Mississippi, shows both the effect of water disposition and the ability of man to counteract it by means of jetties which produce scouring action.

That the waves and tides are materially and constantly modifying the physical geography of the sea coast has been long observed. Places which were once on the very edge of the sea are now removed to the distance of miles from the coast line by the agency of tidal deposit; and others, which were formerly at considerable distance from the water's edge, have since been washed away by tidal erosion. The famous Pass of Thermopylæ, which was, in the time of Herodotus, so narrow that but a small squad of soldiers was necessary to prevent the passage of the whole Persian army, is now separated from the sea by a vast area of marine deposit.

Professor J. E Hilgard, of the United States Coast Survey, has made some interesting observations regarding tidal influence on harbors, and the modifying effects of encroachment to meet the growing necessities of large cities. It is well known that a tidal wave, when uninfluenced by the contour of the coast, is but inconsiderably elevated, and the front slope is about equal in length and similar in form to the rear slope. But as it enters a bay, harbor, or river, the crest of the wave becomes more elevated as the passage for it becomes more constricted, and also the front slope acquires much greater abruptness than the opposite one. Consequently the time occupied by the flood tide is shorter than that occupied by the ebb tide. This phenomenon of tides may be artificially illustrated with a very small amount of water, by dashing a bucketfull horizontally upon some uneven surface, with projecting points and indentations to represent capes and bays. If the water is projected with slow motion, it will be seen to rise but little at the projecting points, and to rise much higher in the indentations or bays, and the slopes of the waves will present the peculiarities already mentioned.

In the Delaware bay and river, the difference between the mean rise and fall at the Delaware Breakwater and at Philadelphia is only 2½ feet, while the difference of luni-tidal interval between the two places is nearly six hours. At the former place, the mean duration of the flood and ebb tides is about the same, showing that the tide wave has here about the same slope on its front and rear sides; while at Philadelphia, the time of ebb exceeds that of flood tide by about 2½ hours. At the head of the Bay of Fundy, the mean hight of the tide is 36 feet, and at spring tides, 50 feet or more. And here the tide rises so rapidly—owing to the very abrupt front slope of the tidal wave—that cattle feeding on the shore, and sometimes people, are often overtaken and engulfed or drowned. In the Severn river, England, above Bristol, the whole rise of 18 feet takes place in 1½ hours, and the fall requires 10 hours. As a result of this variation of slope, when a flood tide enters the mouth of a bay—which is usually a comparatively narrow strait—its rapid flow through the strait carries sand and mud with it; and when the water spreads out in the basin beyond, and thus slackens its velocity, it deposits sediment in extensive flats opposite the entrance. The ebb, being more gradual, only washes little channels which converge from all directions to the outlet, leaving much of the deposit behind. Since the amount of water entering a harbor is about equal to that which leaves it at the next ebb tide, it may seem at first thought that the sediment carried out would just equal that brought in; but when we remember that the rise of water is more rapid than its descent, we clearly see that this cannot be. While, therefore, the accumulation of sediment in well sheltered harbors cannot well be avoided, there is one thing which is very largely under human control, and affects very materially the value of harbors for commercial purposes. Man has it in his power to make deeper or shallower the channels of entrance and exit to a harbor by modifying the water capacity of the enclosed basin.

Professor Hilgard affirms that the depth of the channels "will depend, in a great degree, on the proportion of the area of the basin to the outlet, or, in other terms, on the difference of level which will be reached during the ebb between the basin and the ocean, which determines the greatest velocity and transporting power reached by the ebb stream." And even the flats, which are bare at low water, form an element of importance in fixing the depth of the channel. These flats furnish space for the excess of water at flood tide, and also, by their friction, retard the water in its outward flow. The velocity of water, and hence its scouring effect, is due to the hight of the water column rather than to its area; but while the rapidity of scour is due to its hight, the continuation of its effect must of course depend upon the amount of water. From this we obtain an idea of the risk to harbor navigation which must necessarily attend any encroachment upon the water capacity of a harbor. To emphasize the important lesson he aims to impress, Mr. Hilgard offers as illustrations the two harbors of New York and Charleston.

Of the two entrances to New York harbor, the channel through the Sound is subject to but little natural modification. But it is widely different at the Sandy Hook entrance. In the place where the beacon on the end of Sandy Hook now stands, there was 40 feet of water 15 years before it was built. The cause of this accumulation is attributed to a northward current along both sides of the Hook. This invasion of Sandy Hook upon the best entrance to New York harbor is not a matter to be lightly considered. The depth of this channel, at mean low water, is 22 feet, and is maintained by the water (1) in Raritan Bay and east of Staten Island, (2) in Newark Bay and on Jersey flats, (3) lower waters of the North river, and (4) the Sound tide flowing through Hell Gate. The effect of the last of these is chiefly due to the fact that the Sandy Hook tide wave reaches the docks at New York before that from the Sound, the two meeting at Hell Gate; and the conditions of this tidal circulation are such that, if at the point of meeting a partition were placed, the water on one side would be sometimes 5 feet higher, and at other times 5 feet lower than on the other side. Even in the absence of such a partition, in the most contracted part of the passage the water is often a foot above its level only 100 feet distant. Hilgard estimates that the closing of Hell Gate would cause a loss of not less than 3 feet in the depth of Sandy Hook channel. The effect on this channel of the first three divisions is dependent upon the amount of water and its distance from the bar. The direct and necessary effect of diminishing the area of the tidal basin is to diminish proportionally the depth of the channel. He ventures the assertion that the proposed enterprise of occupying the Jersey flats with docks and wharves "would occasion a loss of not less than 1 foot in the depth of the bar off Sandy Hook, and certainly not more than 2 feet." And he very significantly adds the following remarks, which should not go unheeded: "When we yield to the demands of commerce any portion of the tidal territory, to be used for its wharves and docks, we must do so with full cognizance of the sacrifice we are about to make in the depth of water over the bar; and in order to form any well founded judgment in regard to the effect of such encroachments, it is necessary to be in possession of the fullest knowledge of all the physical facts involved in the problem, and no measure of encroachment should be determined upon except in pursuance of the advice of scientific experts."

Professor Hilgard seems to attribute the cutting-out of harbor channels to the slow ebb scour entirely, and not at all to the more rapid flood tides. The latter would seem to us most likely to produce the greatest scouring effect. And this would be consistent with the two facts stated by him: that sand accumulates at the bar by being thrown up by waves of the sea; and that the inflowing tide carries the sand and mud with which it is charged into the inner basin, and there deposits it, gradually filling up the harbor. In either case, the amount of scour would seem to depend equally upon the capacity of the tidal basin. But it is probable that much of the sediment is washed down the rivers which flow into the harbors, and settles to the bottom, while the river water is backed up in the harbors by the incoming tide.

During the rebellion, a stone fleet was sunk in the channel at the entrance of Charleston harbor, where the channel was 12 feet deep at low water. The submerged fleet caused a shoal to form, so the water here is now only 7 feet deep; but each side of this, a narrow channel has been scoured out, one 12 and the other 14 feet deep. Furthermore, 4 miles south of this point was formerly a much frequented passage for southern traffic; but since the fleet was sunk, this channel, at first 9 feet deep in low water, has become so filled up that it is now only 3 feet deep, very seriously to the disadvantage of easy communication with southern ports. From this, says Professor Hilgard, "we are warned how carefully all the conditions of the hydraulic system of a harbor must be investigated before undertaking to make any change in its natural conditions, lest totally unlooked-for results be produced at points not taken into consideration." S. H. T.

Naval Items.

The United States Steamer Saco has been in commission ten years, and now returns to Mare Island, Cal., to be put out of service. Though the hull is quite rotten, and the boilers worn out, the engine is reported as being as good as on the day it was finished. She has steamed about 150,000 miles.

NAVAL ENGINEER CORPS GAZETTE.

July 20. Chief Engineer J. W. Whittaker and Passed Assistant Engineer J. S. Ogden were detached from the U.S.S. Congress and placed on waiting orders.

July 21. Chief Engineer William J. Lamdin was placed on sick leave, having been condemned by a medical survey, and detached from the Pensacola flagship of the North Pacific station.

July 21. The leave of absence of Passed Assistant Engineer L. W. Robinson, who is assistant to Chief Engineer John S. Albert, U.S.N., Chief of the Bureau of Machinery at the Centennial Exhibition, has been extended six months from the 1st of August next.

THE longer Portland cement is in setting, the better it will be. At the end of a year, 1 part of cement to 1 part of sand is about ½ the strength of neat cement. Strong cement is heavy, blue grey in color, and sets slowly. The less water used in mixing cement, the better.

Japanese Paper.

In Japan, paper finds a very wide field of usefulness, outside of the commoner but perhaps more important applications, for writing, printing, wrapping, and wall paper. The peculiar strength and toughness of Japanese paper fit it for many uses which would hardly be anticipated. Japanese paper handkerchiefs, with which we are all familiar, are quite soft, and pleasant to use, and at the same time nearly as tough as cloth; and from twisted strips of paper torn from these, an excellent string may be temporized, really quite strong and serviceable.

In Japanese houses, paper not only covers the walls and ceilings, but is used on light sliding doors which divide one room from another, and on the folding screens which protect from the too abundant drafts. Light wooden frames, on which a single thickness of paper is stretched, form the windows, admitting light but not sunshine, and air in plenty but not wind. These paper *shoji*, however, as might be expected, fail completely against rain, and must be supplemented by sliding-to or outside wooden storm doors.

Made waterproof with oil, paper serves for umbrella covers and rain coats, and in large sheets is used to protect baggage and merchandise.

In the form of an admirable artificial leather, it is used for pocket books, boxes, etc.

An inferior pasteboard is also made from paper, which is sometimes used for boxes. Thin sheets of wood, however, cut by hand with a large plane, being both cheaper and better, usually replace this material.

Articles of *papier maché* are common, but are usually disguised by lacquer, and can hardly be distinguished from ordinary wooden lacquer ware.

Japanese paper is usually made from the inner bark of the paper mulberry (*Broussonetia papyrifera*), which is grown and cultivated for the purpose. The bark of the *passerina Gampi*, and of the *Edgeworthia papyrifera*, are also said to be used.

Japanese paper is always made by hand, and is therefore of necessity made in small sheets; the more common size, known as *kanshi*, being about nine and a half by twelve and a half inches, though both larger and smaller sizes are used to a limited extent.

The paper as generally sold is unsized, the thick india ink used for writing rendering size unnecessary; but there is special paper called *ro-biki*, or *bidoragami*, very thin and translucent, used for blank books, etc., which forms an exception to this rule. The size used in the manufacture of this paper is said to be made from the bark of a species of hydrangea (*h. paniculata*).

Japanese paper is never bleached, and has usually a faint yellowish or greenish tinge. Its texture is rather loose, and very fibrous. Generally the fibers lie parallel to the shorter edge of the sheet, and in this direction the paper tears easily, while in any other line it tears with difficulty. In certain kinds of paper, made for rain coats, wrapping paper, etc., the fibers seem to cross each other, so that it is difficult to tear the sheet in any direction.

The paper mulberry shrubs, which supply the raw material for papermaking, are grown by the farmers in the vicinity of their villages, on the borders of their rice fields, or on the narrow ridges of earth which divide one rice field from another, and very rarely on ground specially devoted to the purpose.

The scraped and dry bark, in quantities of about 33 lbs., is boiled with a strong lye for about two hours, or until the mass becomes sufficiently tender. It is then put into bags or baskets and submitted to the action of running water, in a stream or irrigation ditch, for twenty-four hours, or until the last trace of alkali has been washed out. The lye used for this treatment is made by lixiviating wood ashes, the ash of the common artemisia being employed. According to Zappe, the ash of buckwheat chaff is also used; and in case the fiber does not readily soften, a small quantity of quicklime is added, though the color of the paper is likely to suffer thereby.

To convert the bark thus treated into pulp, it is next beaten, two or three pounds at a time, on a solid slab of oak or cherry, with short heavy sticks, being frequently turned during the operation, so that the fibers may be broken in every direction. This beating is continued vigorously by two persons for about fifteen minutes: at the end of which time, the few pounds operated on have been pretty thoroughly reduced to pulp.

For the manufacture of paper, this pulp must be mixed with a certain quantity of *tororo* or of rice paste.

Four *kan* (33 lbs.) of bark, scraped and dry, yield two *kan* of finished paper: and will make about three thousand to thirty-six hundred sheets of ordinary size and thickness.

Paper of ordinary weight is usually sold by the *jo*, of ten sheets, and the *so*, of two hundred. With some kind of paper the *jo* is twenty sheets, in others forty-eight. Thick paper is always sold by weight.

The Japanese make numerous varieties of fancy paper, one of the prettiest being known as devil paper. This is a thin tissue paper on which lace-like patterns are printed in opaque white ink, producing the effect of a most elaborate water marking. This paper is used for fancy lanterns, and sometimes for covering *shoji* or window frames, though it is rather thin for this last purpose. Pasted on glass, it makes a very good imitation of ground or etched glass.

Japanese fans, paper for poems, and wall paper are often very beautifully decorated by painting or printing. The patterns are always artistic, consisting generally of leaves, vines, flowers, shoots of bamboo, etc., very naturally arranged. The wall paper in general use is perfectly white,

with a pattern printed in a white opaque ink with a pearly luster. Colored wall papers are rarely used, except for halls and vestibules. This wall paper, like other Japanese papers, is made only in small sheets.

The imitation leather, or leather paper, is made of a special kind of paper, *tozasenka-gami*, of which several layers are employed to give the requisite strength. The inner layers are saturated with oil, *ye-no-abura*, from the fruit of the *Celtis Wildenowiana*, giving the material softness and flexibility. The morocco-like surface is obtained by pressure from an engraved wooden block, and finally the whole is covered with a varnish of lacquer.

"Herr Von Brandt, formerly German Minister to Japan, in a paper* read before the German Asiatic Society, gives a very minute and interesting account of the method of making crape paper, from which I condense the following description: The paper to be craped, ordinary Japanese paper, with some colored design printed upon it, is dampened and spread in a pile on a large slab of wood, in such a way that the edges of no two sheets shall be parallel. Alternating with these sheets are pieces of ordinary white paper, placed between the colored sides of two printed sheets, and sheets of *takanaga* paper. The whole pile is then tightly rolled on a smooth stick, and covered with a long band of dampened linen, rolled diagonally and tightly over the whole. The stick with its roll of paper and cloth is then pressed longitudinally in a rude lever press. The arms of this press are provided with holes through which the ends of the round stick may pass, so that the roll of paper alone receives the pressure. The *takanaga* sheets are made of strong paper, composed of several thicknesses of ordinary paper fastened together with rice paste, which have been previously creased in regular parallel corrugations by a similar process, and which serves to impart the desired regular creasing to the colored sheets when they are together compressed as described. After the first compression, the paper is unrolled from the sticks, and the sheets are separated. The *takanaga* paper is smoothed out, and the pile made up as before, but in such a way that the creasing may come at an angle to the former fold of each sheet. The process is thus repeated seven times, and the sheets finally dried. The paper thus treated resembles crape very closely both in texture and in elasticity.

"The Japanese paper, excellent as it is, does not supply all the wants of the people; and this account would be imperfect did I not allude to the manufacture of paper from rags, after foreign methods, which is now being conducted on a large scale in several parts of Japan. In Tokio alone there are three or more papermills, fitted with the most approved American and English† machinery, and capable of turning out large quantities of paper. The government consumes large amounts of foreign writing paper; the newspapers use foreign printing paper; and the educational institutions require, in addition to these, drawing paper, book paper, etc. All of these are now made in Japan; and it seems likely that the rude and expensive process of making paper by hand, which I have described in these pages, is soon destined to disappear before the power of machinery, which makes a better paper, at less cost, from inferior and less expensive material.—*Henry S. Munroe, E.M., in American Chemist.*

Correspondence.

The Centennial Excursion by the Pennsylvania Railroad.

To the Editor of the Scientific American:

President Thomas A. Scott recently extended to the Centennial judges and many of the foreign commissioners an invitation for a trip over the Pennsylvania Railroad and some of its branches, so planning the same that it should combine, with a practical examination of the line and its auxiliaries and resources, all the features of a pleasure trip as well. By the courtesy of other roads the train ran into New York State to see Watkins Glen, Genesee Falls, and Niagara.

This excursion, occupying five days, was made by about 175 gentlemen, representing the various nationalities of the world, and was in every respect a most delightful affair. The party was conveyed by special train, ample in its accommodations, and represented the convenience of modern travel, including the luxury of elegant lunches while running at fifty miles per hour. The company had provided accommodations along the route at the best hotels, and each evening brought a banquet to crown a pleasant day. While traversing the superb roadway of the main line, occasional stops were made to allow an inspection of some of the fine iron bridges designed by Mr. Wilson, the engineer in charge of these structures. At Altoona the extensive shops of the company were visited; the various methods in the transforming of raw materials into engines, cars, and the various items pertaining to the outfit of a railway were examined with great interest. There was much careful note-taking by the foreign visitors; and indeed a fair field for observation is presented here, as operations are on the largest scale, and the assemblage of mechanical appliances is something marvelous, from the giant derrick that picks up a whole locomotive as if it were a baby, and moves it tenderly to any desired point, to the delicate scroll saw that cuts dainty designs in birdseye maple. The testing of axles was very interesting, as showing the extreme care exercised by the company; one could hardly witness it without an increased feeling of security.

One hundred axles are made from a given melting, and from that number, five are selected promiscuously, as fairly representing the quality of the metal. These are separately laid between heavy blocks which support the extreme ends, and a wedge-shaped iron, weighing 1,640 lbs., is dropped upon the middle, from hights varying from 25 to 40 feet. If they break, the whole one hundred are returned to the furnace; if not, the ninety-five are used; only the five are remelted, these having, of course, been strained by the severe test. Several were thus tried before the visitors, not one breaking. The great steel works of the Cambria and Pennsylvania Companies were also visited, and afforded much valuable information as to the improved method of manipulating iron. On the grounds of the last named, a steam hammer, striking blows of 200 tuns weight, was seen in operation.

At Williamsport, an opportunity was afforded to see one of the largest lumber mills of the country, a huge monster that drags up the helpless logs from the river and, with a roar and a rush, turns them into a million and a quarter of marketable boards per week, feeding itself on the sawdust which is led automatically under the boiler. Rather monotonous food, though it be "fine board," as some one remarked.

The visit to the oil regions was a very interesting feature of the trip, this industry being so peculiarly American. The sight of derricks innumerable, scattered over a strip of country 150 miles long, some working, others silent and abandoned, was suggestive of the singular history of this most singular traffic. It is now conducted upon a methodical and paying system. Thorough investigation was made of the processes by which the petroleum is pumped from depths of 1,400 feet to the tanks of the different owners, whence, after being gaged, it is drawn by union pipe lines, as they are called, and sent through iron veins, nine miles or more, to the railway station, where, loaded into iron cars, it is dispatched on its mission of lighting the world, and reducing the price of gas. During the visit to this strange region, an incident, not in the programme, occurred; a tank containing a million gallons oil was struck by lightning and burnt, causing a scene very impressive, though not without special pleasure to a gas director. The latest decision of Science is that petroleum is not a distillation from coal but from immense masses of coraline deposit. Fossil coral is found overlying the spongy sandstone in which the oil occurs.

The scenery through the diversified valleys of New York and Pennsylvania was greatly admired; while the romance of Watkins Glen and the grandeur of Niagara each contributed their peculiar enjoyment to the party, and the distinguished gentlemen returned to Philadelphia, enthusiastic over the trip. Colonel Scott was unable to accompany them, but was happily represented by his subordinates, who not only illustrate, in the highest sense, the rare abilities necessary to the best type of modern railway management, but are thorough gentlemen, understanding how to exercise republican hospitality with a grace which called forth the admiration of the foreign and the pride of the native born guests. It is not too much to say that their courteous consideration put hunger, thirst, and discomfort out of the question, and rendered the trip, from beginning to end, a continual holiday.

One very delightful fruit of the excursion was the evident fraternal feeling produced among the gentlemen of different nationalities, brought together under circumstances so favorable to the development of pleasant sentiment. Its expression was frequent and earnest; and when, after a superb dinner at the Cataract House, Niagara, they joined voices in singing with the band each others' national airs, it seemed as if one of the noblest results to go out from our Centennial observance was already in part realized, the quickening of the sentiment of universal brotherhood. Honor to Colonel Scott for conceiving and carrying out so delightful and so useful a scheme. G. S. D.

Aerotherapy.

To the Editor of the Scientific American:

In your issue of July 29, it is stated anomously, that aerotherapy in medical treatment by compressed air is new. I saw it in 1857 at Benn Rhydding, in Yorkshire, England, at a great hydropathic establishment, where there was an apartment of iron, very handsomely fitted up, for the purpose. And in 1875 I saw another, which had been in operation for many years at the Townsend House, the spacious and elegant establishment of Dr. Grindrod, at Malvern, Herefordshire, England.

Portland, Me. NEAL DOW.

Logwood Inks.

Logwood inks have been much employed for several years on account of their cheapness and the beauty of their tint; the greater part of the so-called copying inks are prepared at the present time from this coloring matter. Both the rasped logwood and the commercial extract are subject to falsifications; it is well, therefore, to make use of the whole logwood, and rasp or grind it as required; it is necessary, also, to consider the presence of an excess of moisture and of foreign substances, which may be used to adulterate it, as insoluble substances, cutch, etc.

The inks prepared from logwood are of four classes: 1. Inks with logwood and chrome; 2, inks with logwood and alum; 3, inks with logwood and copper; 4, inks with logwood and iron

Runge, in 1848, discovered that a dilute solution of the coloring matter of logwood, to which had been added a small quantity of neutral chromate of potassium, produces a deep black liquid, which remains clear, does not deposit, and may be employed as an ink. Perfectly neutral litmus paper is not affected by it; it does not attack pens; it is very cheap, and so easily penetrates writing paper that it cannot be removed by washing even with a sponge—in a word, it has all the properties of an excellent ink. On exposure to the air in the inkstand, it sometimes decomposes very rapidly, its coloring matter being deposited in the form of large black flakes, which leave a colorless liquid above them. This gelatinization is a great defect in this ink, particularly as one does not know the precise conditions which determine it. Different means have been proposed to prevent this action; the best seems to be that of the addition of carbonate of sodium recommended by Böttger.

The author has used an ink prepared in this manner for upwards of two years, and has not observed any decomposition, although this may to a considerable extent be due to the fact that the inkstand employed was one which allowed but little exposure to the air.

To prepare this ink, take extract of logwood, 15 parts; water, 1,000 parts; crystallized carbonate of sodium, 4 parts; neutral chromate of potassium, 1 part.

Dissolve the extract of logwood in 900 parts of water, allow it to deposit, decant, heat to ebullition, and add the carbonate of soda; lastly, add, drop by drop, with constant stirring, a solution of the neutral chromate in 100 parts of water. The ink thus obtained has a fine bluish black color; it flows well from the pen and dries readily. The chrome ink powder of Platzer and the acid ink of Poncelet are imitations of the original ink of Runge.

An ink obtained from a decoction of logwood and chrome alum is not to be recommended; the characters written with it have little depth of color, and are of a somewhat greyish shade.

Decoctions of logwood to which alum has been added give a reddish or violet color, which darkens slowly, particularly with ink prepared from the wood and not the extract. Such inks prepared with alum alone are costly, because to obtain a sufficiently deep tint one is obliged to employ decoctions or solutions of the extract in a very concentrated condition. It is otherwise when a metallic salt is added along with the alum. Alum produces a reddish purple color in decoc ons of logwood, while metallic salts produce in the oxidized solution of the coloring matter a precipitate of a black or b lu ish black color. These inks are analogous to the so-called alizarine inks; the ink is colored by the tint produced by the alum. Under the influence of air there is produced between the metallic salts and the coloring matter a reaction which determines the formation of a bluish black precipitate. To prevent as much as possible this action of the air upon the ink before it is applied to the paper, there is added, as in the case of alizarine inks, a trace of sulphuric acid, designed to dissolve the precipitate which may be produced. This acidity of the ink has several disadvantages; it attacks the pens used for writing with it unless they are either of gold, platinum, or gutta percha. Sulphate of copper or sulphate of iron may be the metallic salt used in such inks—the former is preferable. One of the best formulas for this kind of ink is the following, given in proportions for a manufacturing scale: 20 parts, by weight, of extract of logwood are dissolved in 200 parts of water, and the solution clarified by subsidence and decantation. A yellowish brown liquid is thus obtained. In another vessel, 10 parts of ammonia alum are dissolved in 20 parts of boiling water; the two solutions are mixed, there being also added $\frac{1}{2}$ part of sulphuric acid, and finally $1\frac{1}{2}$ parts of sulphate of copper. The ink should be exposed to the air for a few days to give a good color, after which it should be stored in well corked bottles.

Böttger gives the following formula: 30 parts of extract of logwood are dissolved in 250 parts of water; 8 parts of crystallized carbonate of soda and 30 parts of glycerin of density 1·25 are added; and lastly, 1 part of yellow chromate of potassium and 8 parts of gum arabic, reduced to a powder and dissolved in several parts of water. This ink does not attack pens, does not mold, and is very black.—*E. U. Viedt.*

Facts and Simple Formulæ for Mechanics, Farmers, and Engineers.

Two hundred and seventy cubic feet of new meadow hay and 216 and 243 feet from large or red stacks will weigh a tun; 297 to 324 cubic feet of dry clover will weigh a tun.

Laths are $1\frac{1}{2}$ to $1\frac{1}{4}$ inches by 4 feet in length, are usually set $\frac{1}{4}$ of an inch apart, and a bundle contains 100.

A tarred rope is about one fourth weaker than untarred white rope. Tarred hemp and manilla ropes are of about equal strength. Wire rope of the same strength as new hemp rope will run on the same sized sheaves; but the greater the diameter of the latter, the longer it will wear. One wire rope will usually outlast three hemp ropes. Running wire rope needs no protection; standing rigging should be kept well painted or tarred.

The coefficient of friction of leather belts over wooden drums is 0·47 of the pressure, and over turned cast iron pulleys 0·28 of the pressure.

A mixture of 9 parts phosphate of soda, 6 parts nitrate of ammonia, and 4 parts dilute nitric acid is a freezing compound which will cause a fall in temperature of 71° Fah.

Three fourths of a cubic foot of water evaporated per hour will produce 1 horse power.

Cold blast iron is stronger than hot blast. Annealing cast-iron diminishes its tensile strength.

The safe load in tuns which an iron chain will withstand equals the square of the diameter divided by 9.

* "Die Anfertigung des Krepp papiers, Tahirimengami," Mittheilungen des Deutsches Gesellschaft, 5tes Heft, Juli, 1874, s. 3.

† See Engineering, vol. XXI. pp. 400, 422.

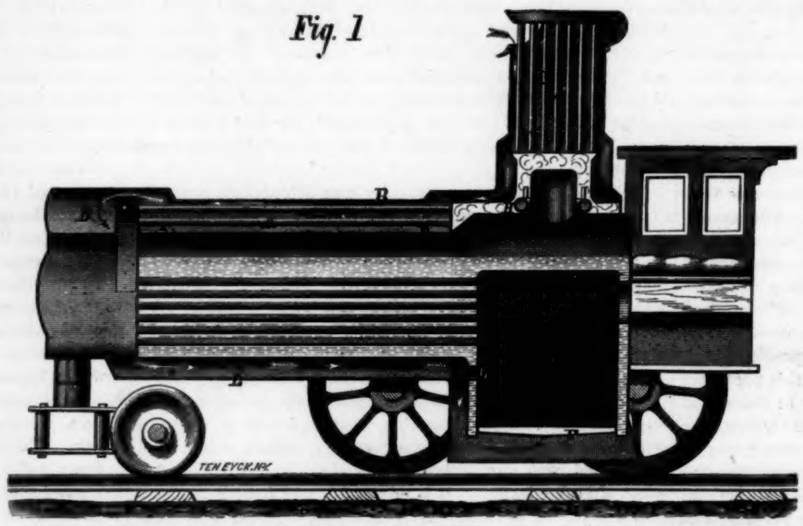
IMPROVED DEVICE FOR HEATING AIR FOR FURNACES.

The invention herewith illustrated is designed to economize fuel through feeding the furnace with hot air for the support of combustion. The waste heat of the furnace is utilized to warm the entering draft, and the devices adopted for effecting this include a hot jacket for the boiler, which is another source of economy. The engraving represents the invention in longitudinal section, Fig. 1, and transverse section, Fig. 2, as applied to a locomotive boiler.

The products of combustion pass as usual through the boiler flues to the smoke box, and thence by tubes, A, extending through casings, B, to the building, whence they escape through the tubes, C, forming the smoke pipe. Surrounding tubes, C, is a casing into which the incoming cold air enters through the hood, as shown by the arrows, passes down into the casings, B, and along to jacket, D. The draft then passes to another casing, E, at the bottom, and finally enters the ash pit at F.

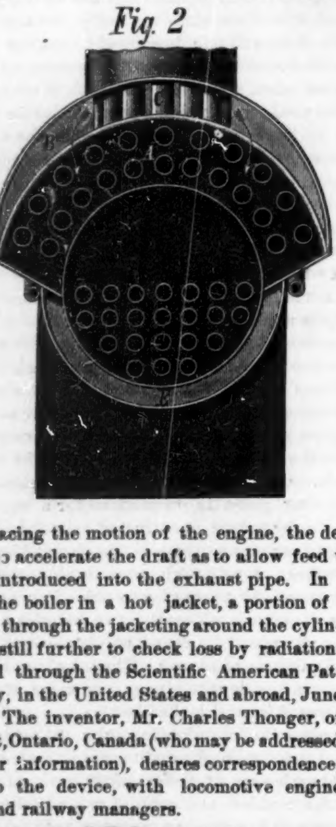
The hood on the smoke stack is made to turn so as to be adjusted to the motion of the engine. The water space at the back of the furnace may be provided with tubes, G, in place of stay bolts. These, leading into the hot air passage will, it is claimed, cause a current of heated air to be thrown in above the fuel to burn the smoke. They may be provided with dampers to regulate the current. The exhaust pipes are led into a coil or ring, at H, surrounding the steam dome. In the ring are numerous jets, so placed as to play into the annular space contained between the dome and casing, thus dividing the fresh air from the smoke. This arrangement, the inventor states, will allow of a much larger area than is usually given to the chimney of a locomotive, insuring a corresponding strength and steadiness of draft. It is also claimed that, in combination with

Fig. 1



THONGER'S DEVICE FOR HEATING AIR FOR FURNACES.

Fig. 2



the hood facing the motion of the engine, the device would probably so accelerate the draft as to allow feed water heaters to be introduced into the exhaust pipe. In addition to encasing the boiler in a hot jacket, a portion of the hot air may be led through the jacketing around the cylinders so as still further to check loss by radiation.

Patented through the Scientific American Patent Agency, in the United States and abroad, June 20, 1876. The inventor, Mr. Charles Thonger, of Courtright, Ontario, Canada (who may be addressed for further information), desires correspondence, relative to the device, with locomotive engine builders and railway managers.

IMPROVED STEP AND EXTENSION LADDER.

We illustrate herewith a new ladder, which will doubtless prove convenient and useful for house and store use, for painters, for fruit gathering, etc. As represented in the engravings, it is constructed somewhat similarly to an ordinary step ladder, being really two ladders (one with steps and one with rounds) hinged together. We are informed that it is as simple and light as an ordinary step-ladder, and can be lengthened to double its length by simply swinging the ladder with the rounds upward, which can be done by anyone in a moment. When arranged as a step ladder, it can be used by two persons at the same time, one going up either side. One size of hinge will answer for any size or length of ladder, as the hinges are adjustable to various widths and thicknesses of wood. The locking bar is self-acting, and will lock the ladder together when not in use, as shown in Fig. 1. Fig. 2 represents the ladder in position as a stepladder, the same locking bar holding it, and Fig. 3 shows the ladder extended, the same locking bar again securing it. The inventor claims that the device can be manufactured as cheaply as any ordinary step ladder, and will find a ready market. Patented January 11 and April 11, 1876, by E. J. Schneider. For further information address M. Schneider & Sons, 35 South Main street, Dayton, Ohio.

Fig. 4 Fig. 3 Fig. 1 Fig. 2

SCHNEIDER'S STEP AND EXTENSION LADDER.

A Gigantic Bird from New Mexico.

Professor Cope exhibited, recently, to the Philadelphia Academy of Science a tarso-metatarsus of a bird, discovered by himself during the explorations in New Mexico, conducted by Lieutenant G. M. Wheeler, U. S. A. The character of its proximal extremity resembles in many points those of the order *cursores* (represented by the *struthionidæ* and *dinornis*); while those of the distal end are, in the middle and inner trochleæ, like those of the *gastornis* of the Paris basin. Its size indicates a species with feet twice the bulk of those of the ostrich. The discovery introduces this group of birds to the known *faunæ* of North America, recent and extinct, and demonstrates that this continent has not been destitute of the gigantic form of birds, heretofore chiefly found in the Southern Hemisphere *faunæ*.

Birds with Teeth.

The same author has also recently given an interesting account of a remarkable group of birds with teeth, obtained from the cretaceous beds of Kansas, where the associated vertebrate fossils are mainly mososauroid reptiles and pterodactyls. They constitute a sub-class, odontornithes, comprising two orders: The *ichthyornithes*, having teeth in sockets, biconcave vertebræ, a keeled sternum, and wings well developed, represented by ichthyornis and probably apatornis, and the *odontolcæ*, with the teeth in grooves, the vertebræ as in recent birds, a sternum without keel, and rudimentary wings, represented by hesperornis. The occurrence of toothed birds in England has been described by Professor Owen from the London clay of Sheppy.

The Hoosac Tunnel.

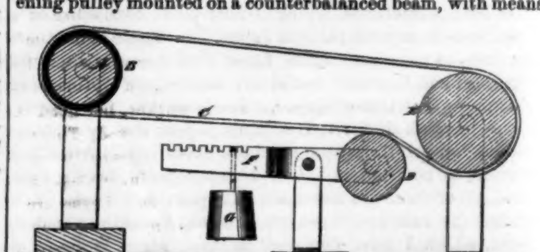
The North Adams *Transcript* says the temperature of the Hoosac Tunnel, at North Adams, Mass., is about the same all the year round, the thermometer standing generally at 60°. The air is pure except when there are a great many trains going through, filling the tunnel with smoke, the tunnel being able to thoroughly ventilate itself under ordinary circumstances.

The brick arching is not all in any one place, but in sections, wherever there was a possibility of danger from loose and crumbling rock. In all, about four thousand five hundred feet have been arched, the longest section being five hundred and the shortest ten feet. Thus the workmen were not all together, but were scattered along the line. After a section of the tunnel had been selected as needing arching, the miners began to remove the rock from the sides and roof for a depth of about three feet, that being the average thickness of the arching. In performing this work constant care was used; and when the extreme liability to danger from falling rock is considered, it is a wonder that so few accidents have occurred. The rock taken down was removed daily and dumped at different points along the road from the tunnel, that from the roof being received and carried out by platform cars that reached within a few feet of it. When the section to be arched had been properly prepared, the masons began their work, laying the brick on wooden centers, which were put up every five or six feet. The brick work was not laid close to the wall in all parts, a space being left for the water to run down. Sheet iron was placed between the brick and the wall for protection against water, and the brick was laid with waterproof cement. No part of the arching has been slighted, the whole work being carefully and thoroughly done.

A telegraph wire has been put through the tunnel, and offices stationed at both ends, and warning will be given every time a train enters and leaves the tunnel. Manager Prescott has appointed R. B. Campbell superintendent of the tunnel, for the present at least, and Mr. Campbell keeps ten men examining the sides and roof and taking down loose rock wherever found. Before each train goes through, the entire length of the tunnel is walked over by four men, stationed at different points, to see that the track is unobstructed The length of the tunnel is a little under five miles.

IMPROVED SPEED GOVERNOR.

Mr. James M. King, Walnut Station, Minn., has recently invented a simple and practical regulator for the clearing apparatus of thrashing machines, to compensate for the irregular motion of the horse power. It consists of a belt-tightening pulley mounted on a counterbalanced beam, with means



for regulating the tension of the belt, and a slipping pulley or cover on the driving pulley. A is the driving pulley; B, the slipping pulley or slipping cover of the driving pulley; C the transmitting band; D the counterbalance tension pulley, and E the pulley to be driven. The tension pulley, D, is, in this example, controlled by an adjusting weight, G, on lever, F; but it may be actuated by other means, if preferred.

The invention was patented on May 30, 1876.

The New U. S. Steamer Trenton.

The Trenton is said to be one of the finest and probably fastest vessels in the naval service, being fitted with compound engines, two low pressure and one high pressure cylinders, the former 78 inches in diameter, and the latter 58½ inches in diameter, and all of 4 feet stroke, with an indicated 3,500 horse power. She has eight cylindrical boilers, 12 feet in diameter, and 10·25 feet long, with 510 feet of grate surface, and 12,000 feet of heating surface. The propeller is the Hirsch four-bladed screw, 19·5 feet diameter, and 28 feet mean pitch The length of the vessel is 253 feet between perpendiculars, 48 feet beam, and 23 feet depth of hold from main deck. She is to be full ship rigged, and will be armed with eleven 8-inch rifled guns. She is also to be a ram, being provided with a prow extending eight feet beyond the bow. The vessel, of 2,300 tuns burden, was designed by Naval Constructor Isaiah Hanscom. Heretofore it has been difficult to make the sailors comfortable in cold weather, owing to the danger of the heating apparatus, from bursting tubes, and the necessity of shutting off the steam at night in order to sleep. This annoyance has been overcome by adopting a new open-base radiator, which is so arranged that water can never accumulate in the pipes from condensation, causing unequal expansion and frequent bursting of the tubes. Another improvement for the comfort of the sailors is a new kind of galley, capable of cooking for a force of 800 men at once, and in less time than has been consumed heretofore.

The Trenton will be capable of going at a mean speed of 13 knots, is very strongly built and braced, and will be, it is expected, one of the most formidable cruisers of the navy.

BEES AND THEIR INSTITUTIONS.

[We extract from a contemporary magazine, entitled *Home and School*, a most excellent educational monthly, published by J. P. Morton & Co., Louisville, Ky., the following article on the instinct and habits of the bee. It is from the pen of a lady, Sophie B. Herrick, who evidently understands her subject; and it is so well written that we forbear to alter or curtail it.—EDS.]

It is both curious and interesting to study the government, the laws, the political economy of a kingdom which is precisely the same today that it was six thousand years ago; whose antiquity is so great that it enjoyed an ancient rule when China, Assyria, and Persia were still in their infancy. The bees have not only possessed a stable and orderly government through all these centuries, but they have managed to retain their character as models of wisdom, industry, and thrift, while nation after nation has sprung into being, lived its day, and then dwindled away into insignificance.

Fig. 1.—DOMESTIC BEES.

Many of the lessons which man learns only by bitter experience a thousand times repeated seem to have been stamped by the divine power upon the very entity of the lower creation; and this, if nothing else, would make their habits, instincts, and life history well worth our study.

In every swarm there are three kinds of bees, which not only differ from each other in form and structure, but whose functions are entirely distinct. These are the queen bee, the workers, and the drones (Fig. 1). The queen, who is the only perfect female in the hive, is the mother of the whole swarm. In shape she is easily distinguished from the other bees: her body is long and slender, her wings small but strong and sinewy, her legs are wanting in the brush and pollen basket which characterize the worker, her head is in form a flattened sphere, and her sting is curved. The workers were supposed to be sexless till the delicate dissections of Mdlle. Jurnie, at the suggestion of Huber, determined them to be imperfectly developed females. These are the smallest bees in the hive; their bodies are shorter than that of the queen, their wings of the same size. The four hinder legs are furnished with brushes of stiff hair, with which to collect pollen; the two hindmost with spoon-shaped cavities, in which it is packed away for transportation to the hive (Fig. 2). The head of the worker is triangular, and its sting straight. The drones are the males; in size they are about one third larger than the workers; in form they are thicker, and in color darker. Their jaws and probosces are shorter than those of the common bee; they are destitute of brushes, pollen baskets, and stings, and have heads somewhat similar to the queen.

Fig. 2.—LEG OF BEE (magnified).

Fig. 3.—INTERIOR OF AN OLD-FASHIONED HIVE.

There is, unless in exceptional cases, only one queen in a swarm; her function is simply to supply her realm with subjects. The workers number from ten thousand to sixty thousand; they perform the whole labor of the hive; they rear the young, defend the common home, stand sentinels at its entrances, collect and store the provisions, elaborate the wax, build the comb, guard, attend, and provide for the queen, and take charge of the sanitary department. The drones perform no work of any kind, and seldom exceed fifteen hundred in an ordinary swarm.

There are two other kinds of bees noticed by apiarians which are frequently found in swarms; these they call the black bee and the captain bee. They both, upon microscopic examination and careful dissection, show an internal structure identical with that of the worker. It seems to be very well established now that the black bee is only a demoralized worker, who, having once tasted the sweets of stolen fruits, has abandoned honest labor, and given himself up to pilfering as a profession. Squeezing through small holes in the pursuit of his nefarious business, he has bedaubed himself with honey, and so plastered down and darkened the delicate plumage of his body. The captain bee has probably unintentionally adorned himself with the pollinia of some orchidous plant, and in this way gained the top knot which distinguishes him from his comrades.

The old-fashioned beehives (Fig. 3) were so constructed that the whole internal economy of the colony was a mystery. Nothing of it could be ascertained except in the examination of results after the destruction of the colony. Though some of the ancients devoted years to the study of the habits of these insects, a large proportion of the results given to the world was almost valueless. Fact was so mixed up with fancy, observation with conjecture, that the value of the whole was greatly impaired. Some of these difficulties have been removed by the introduction of glass observing hives, though many still beset every observer, from the fact that bees love the darkness, and in every way endeavor to obscure their movements within the hive from observation.

We will suppose that we are observing a new hive into which a swarm of bees has been introduced in order that every peculiarity of bee life and work may be considered in their natural order Before the swarm left the old hive, each bee had gorged itself with honey; beside this provision, a quantity of filled comb is generally supplied to them, so that they may not suffer in their new home.

Fig. 4.—CLUSTER OF BEES.

Before anything else can be done, comb must be built. A number of the workers, therefore, fill themselves with honey and suspend themselves in festoons or curtains (Fig. 4), and there they remain motionless for about twenty-four hours. At the end of that time, in the little depressions on the under side of the abdomen, between the overlapping rings of the body (Fig. 5), will be seen thin scales of pure white wax. It is a kind of external fat secreted by the bee from the honey it has assimilated, much as the fat of animals is secreted, especially from saccharine food. Some of these scales are solid wax, others thin films, and others again only delicate spiculæ. Bees, like the higher animals, do not all secrete the same amount of fatty matter from a given quantity of food.

The bees loosen themselves, and one of their number, using the pincers at the joint of one of its third pair of limbs, seizes a wax scale from its own body and brings it to its mouth. The scale is turned about in every direction by the claws, and its edge is broken down and off by the mouth of the bee. These particles are then accumulated in the hollows of the mandibles, from which it issues in the form of a very narrow ribbon. The tongue, during this operation, assumes a great variety of shapes, being sometimes flattened like a trowel and again pointed like a pencil. After the tongue has imbued the whole ribbon with a frothy saliva, which gives to the wax opacity and adhesiveness, it is again accumulated in the mandibles, and again issues forth in the ribbon-like form. The wax thus prepared is applied to the vault of the hive by a single bee (Fig. 6). After the store of wax of this founder bee is exhausted, others follow. Though there is perfect harmony among the builders, there is no coöperation in the true sense of the word, unless the fact that the many wait, while the one assumes the part of architect and lays the foundation, can be called coöperation. A solid arch of wax is built in an inverted position in the upper part of the hive. These little insects always prefer to begin at the top and build downward, though their instinct is wonderfully flexible in its power of conforming itself to circumstances; and if they are prevented from building in one direction, they build in another. Cells are then excavated from this arch, and after the foundation is dug the remainder of the comb is built upon it (Fig. 7). Ordinary cells are six-sided, but the upper rows in the comb are necessarily only five-sided. The six-sided cells are of two sizes: those built for worker broods number twenty-five, and those for drone broods sixteen, to the square inch. The royal cells we will describe later. The comb, when finished, consists of a sheet of double cells arranged back to back with the utmost nicety, so that the greatest economy of space and material is secured (Fig. 8). Maraldi, the inventor of the glass hives, measured the angles of the cells with great care; he found them to be respectively 109° 28′ and 70° 32′. M. Kœnig, a well known mathematician, without any previous knowledge of this measurement, was requested to determine by calculation what should be the angles of a hexagonal tube with a pyramidal base, in order that the least possible material should enter into its construction. His angles, reached by the methods of calculus, were 109° 26′ and 70° 34′.

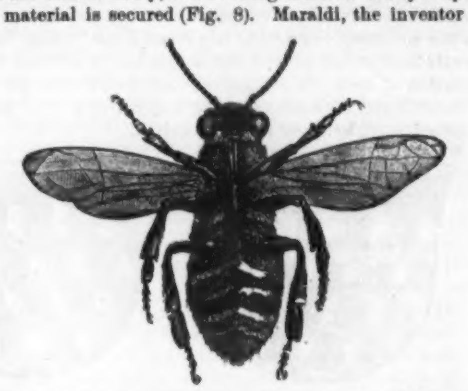


Fig. 5.—BEE (magnified), SHOWING THE WAX BETWEEN THE SEGMENTS.

In curving their comb, as they are sometimes forced to do, and in conforming themselves to many adverse circumstances, bees often show wonderful wisdom and skill in the variation of size and shape in their cells. In curved comb, for instance, the shape of every individual cell must be changed from the ordinary hexagonal tube with parallel sides. In this case the bases of the double row of cells are of the usual size and shape; the cells on the concave side of the comb narrow from the base to the open end, while those on the convex side widen. When a transition from worker to drone comb, or *vice versâ*, is necessary, it is effected by interposing several rows of cells of gradually increasing or decreasing size. These irregular cells are used for the storing of provisions, never for food.

When first completed the comb is pure white and very brittle; it is afterward strengthened and somewhat discolored by the addition of propolis. This is a gum collected from certain trees by the bees, and is used to make the hives both airtight and watertight. The fragile white comb is sometimes varnished with a thin coating of propolis, and at times the bees have been observed pulling down the first built comb, and working the wax over with an admixture of this gum. The propolis is often kept ready for use in a lump placed in an accessible part of the hive. In this form it hardens till it is almost like stone; when the bees desire to use it, they have been observed to soften it by the application of the same saliva with which they imbue the wax.

When sufficient comb has been supplied to the hive the workers begin to collect stores; they rove the fields for pollen and honey. The pollen dust is gathered by the bee with its brushes and packed away in the pollen basket. It is generally collected in the morning, while the moisture renders it cohesive enough to be formed into the little balls with which they fill their baskets. When this is impossible, in consequence of the dryness of the air, the bee rolls himself in the pollen, and flies home as dusty as any miller. In the hive the farina is collected from his body and packed away. It has been known since the days of Aristotle that these little insects never store the pollen of different flowers in the same cell. Each bee comes home loaded with a homogeneous mass, and no temptation is sufficient to induce him to visit more than one kind of blossom in a single excursion. If the flowers visited by the bee yield both pollen and honey, he loads himself with both on the same trip.

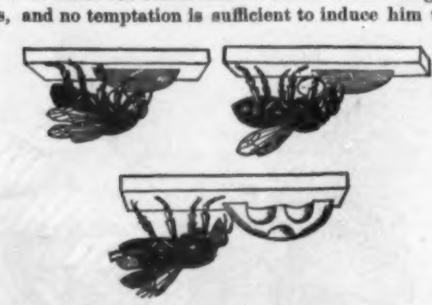


Fig. 6.—BEES CONSTRUCTING CELLS.

The honey is gathered by means of the bee's mouth, which is a most complicated organ (Fig. 9). The proboscis penetrates the nectarium of the flower; by the aid of the tongue and other portions of the mouth, the honey is drawn up and conveyed into the honey receptacle—a sort of second stomach surrounded by powerful muscles, which enable the bee to regurgitate its contents when it reaches the hive. The saccharine secretion of flowers undoubtedly undergoes some

change while in the stomach of the bee. Honey made from the clover, sugar and water, from fruit juice, does not possess a flavor that would reveal the source from which it had been obtained. The taste is not, however, wholly independent of its source: certain plants yield much more delicate honey than others. The honey of Mount Hymettus, of Narbonne, and of Pontus, all owe their exquisite and peculiar flavors to the plants frequented by the bees.

These provisions stored by the bees have their specific uses. The honey is used as food for the mature bees, and is the material from which wax is secreted. The pollen forms the food of the larvæ, and supplies to them the nitrogenous matter necessary to growing larvæ and pupæ. Many experiments have at last proved that pollen has its use also in the secretion of wax. With pollen alone bees secrete no wax; without it and with abundance of honey they at first secrete it abundantly, but soon seem exhausted.

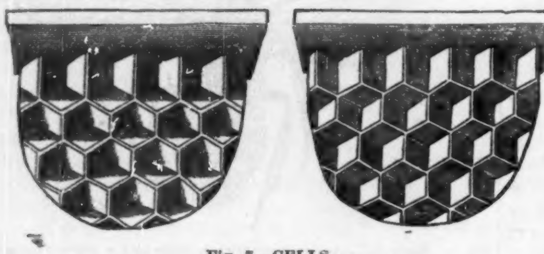


Fig. 7.—CELLS.

As our hive is supposed to be supplied with a perfect, fertile queen, it will be necessary to go back a little. An old queen almost invariably leads off the swarm. She is therefore ready to begin stocking the comb with brood as soon as the workers have built it. Soon after our queen was hatched in the parent swarm, she took her first and only flight, with the exception of that in swarming time. A single fertilization is sufficient to impregnate the hundreds of thousands of eggs laid by the queen during her life of several years. Like many other insects she is fecundated on the wing. Dr. Joseph Leidy, of Philadelphia, by the aid of microscopic investigation, discovered a small sack opening into the oviduct

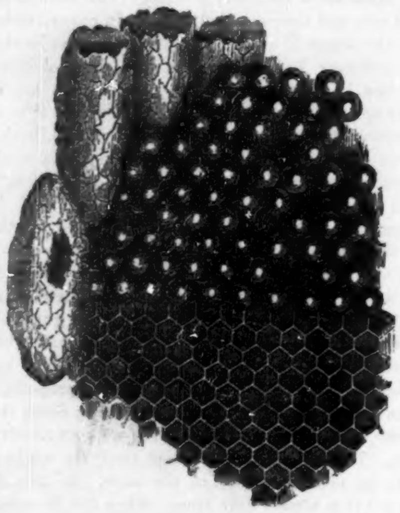


Fig. 8.—PART OF COMB.

of the queen, which is the permanent receptacle of the spermatic fluid. Dzierzon, Von Siebold, and, in fact, all the greatest living naturalists of the world, have been forced into the remarkable conclusion that female bees, workers, and queens are produced from fertilized, and drones from unfertilized, eggs. The sex of the egg is determined by several causes: if the queen from any malformation of the wings is unable to leave the hive, if she does not effect her flight before the expiration of three weeks from the time she is hatched, if she is starved for twenty-four hours, if she is subjected to intense cold for any length of time, and when she becomes old, she lays only drone eggs. The microscope proves that in each of these cases the spermatic sack has withered away, and can no longer perform its function of vivifying the eggs as they pass it. How the queen is able to effect this fertilization at will, though an ascertained fact, is an unexplained mystery.

While thousands of busy workers have been laying in provision for the young of their swarm and for themselves, the queen has not been idle. She has been actively employed in supplying the brood comb with eggs, sometimes to the number of three thousand a day. She generally begins the season with laying only worker eggs; these she is very careful to deposit only in their appropriate cells. If by accident or by way of experiment the hive possesses only drone comb, the queen will drop her eggs about anywhere rather than place them in the wrong cells, where they will not only perish, but, in all probability, fill the comb to no purpose.

Fig. 9.—HEAD OF THE HIVE BEE (magnified).

Although the queen knows what kind of an egg she is about to lay, the workers cannot distinguish their sex, as has been proved by repeated experiments. This discriminating instinct, which is perfect in the fertile queen, is wanting to the unfertilized drone-laying queen. She will frequently deposit her drone eggs in worker cells, or on the edge of comb, or any where else, though there may be empty drone comb in the hive. The bees have a wonderful way of dividing their labor, and then taking it for granted that each portion has been faithfully done. Where the workers find eggs in comb they assume that the queen has performed her part well, and they give it the treatment appropriate to the brood which should be found in that particular kind of cell.

After the eggs are laid they remain apparently unchanged for three or four days (according to the kind of bee which is to be developed); each one then hatches out into a small white maggot. The smaller workers, called nurse bees, now devote themselves unweariedly to the care of the larvæ. They swallow the pollen, with probably a minute quantity of honey, and after a partial digestion regurgitate it for the benefit of the young. The food is not only administered to the baby bees, but they appear to be always immersed in a sort of bath of the jelly-like substance, and to take in as much of their nutriment by absorption as by direct feeding. The little nurses are models of watchfulness and care; but occasionally they have to be reminded of their duties by the tapping of the baby bee against the side of the cradle. When the nurses think it time to feed their charges, the attention of the larvæ is attracted by some motion on their part, and the always welcome food administered. In four or six days the larva has reached maturity; the nurse bees then cap over its cell with a brown, porous, convex cover—the caps of the drone cells being more curved than those of the workers. The amount of food supplied to the maggot is ample, but it is carefully proportioned to its needs; no food is ever left in the cell when the workers close it in to undergo its final transformation.

Huber's observations of the cocoon spinning were made through the walls of blown glass cells into which the eggs had been removed. Two minute threads issue from the larva's upper lip; these become gummed together at a short distance from the mouth. The constant shortening and lengthening of its body finally enables it to complete its delicate silky covering. The common bees completely envelope themselves, whils the queen spins a partial cocoon,

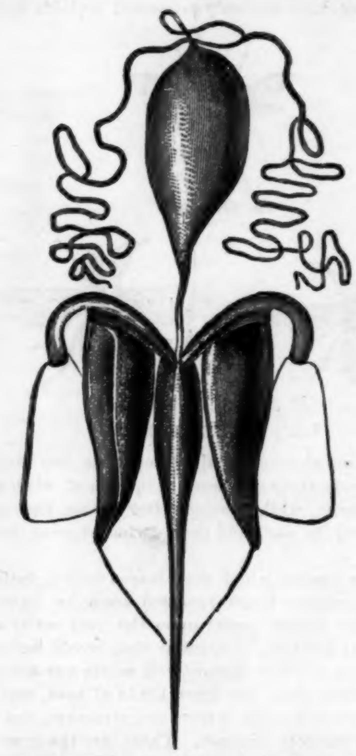


Fig. 10.—STING AND VENOM GLANDS (magnified).

which only reaches to the second abdominal ring. The cocoon done, the bee has reached the second of its transformations, and becomes a nymph or pupa.

The drones require twenty-four days, the workers twenty, and the queen sixteen, to complete their development, from the laying of the eggs to emergence as a perfect insect. When the time for their exit comes, the common bees make

Fig. 11.—FERTILE WORKER. QUEEN, NOT BORN BUT BRED.

their way out of the cells as best they can, while the queen receives every care and assistance. In this the common bees would seem to need help far more than the queens, since their cocoons bind them more closely.

Each insect, as it quits the cell in which it was reared, leaves behind it its cocoon. As soon as a cell is vacated, some of the workers go in to clean it out and prepare it for future use; in doing this the film of silky threads is not removed, but is incorporated into the walls of the cell; as many as seven of these cocoons have been removed, one after the other, from a single brood cell. While the successive deposit of the cocoons strengthens the comb, it also contracts the cells, and in these smaller apartments the nurse bees are

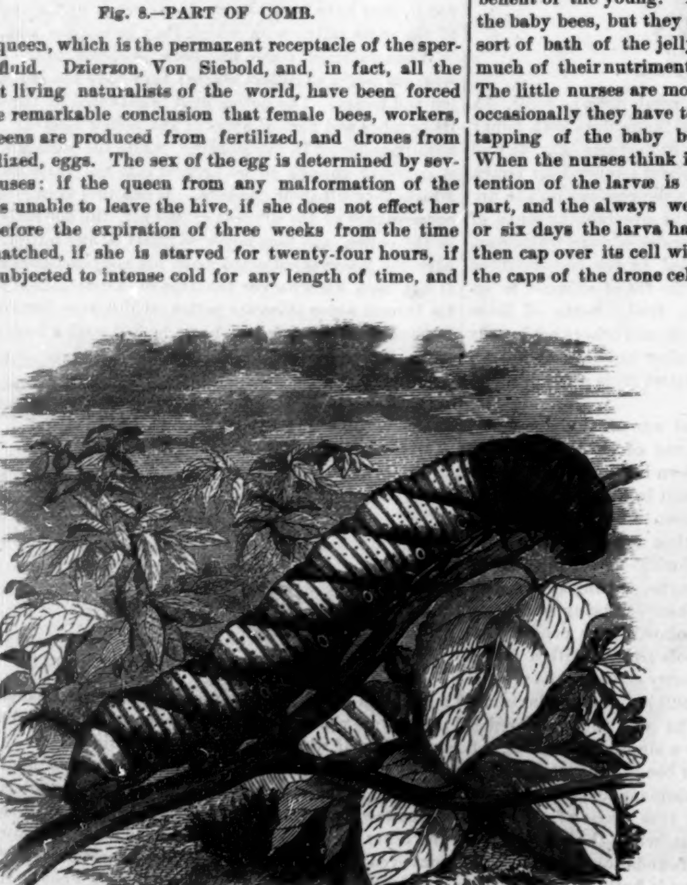


Fig. 12.—LARVA OF THE DEATH'S HEAD MOTH.

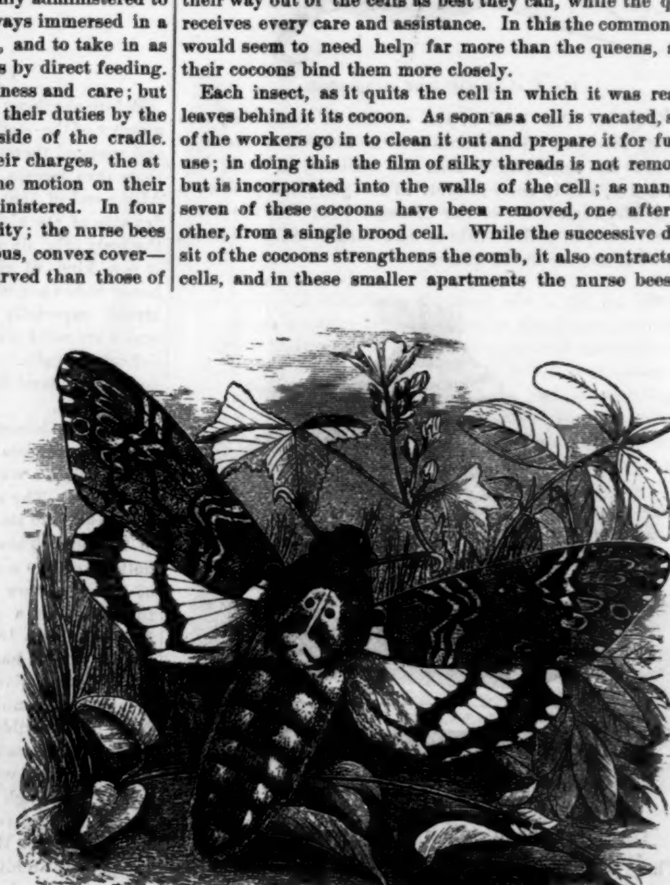


Fig. 13.—THE DEATH'S HEAD MOTH.

reared. These bees differ from the other workers only in their size and in the functions which they fulfill.

A colony of bees frequently becomes queenless either by accident or through natural causes. In this case a most singular scene may be witnessed in the hive. The bees leave their ordinary work when the news has been communicated throughout the hive; they huddle together as if in the deepest consternation. A great buzz, apparently of consultation, is heard. Finally they seem to come to the conclusion that there is no mending the matter, and they agree to set to work to make another queen. Several worker larvæ, in cells not adjacent, are selected and devoted to royalty. (Several are chosen, to provide against contingent loss). The worker maggot chosen may be two or even three days old. The first thing the bees do to each of the selected larvæ is to enlarge its cell by cutting away the partition walls of three adjacent cells, thus throwing them into a single apartment. The worms occupying two of these three cells are destroyed, and all the ordinary food removed. The maggot is then supplied with different food, known as royal jelly, and with a much larger quantity of it. This jelly is a translucent substance, possessing a slight acidity and astringency of taste. The embryo bee which has been taken from the ranks and anointed queen receives the most devoted attention. She is royally supplied with a superabundance of food. When she is ready to go into the condition of a nymph, the bees cap her cell over with a pendent convex cover; and the cell looks, in this condition, more like a roasted peanut than anything else. When the queen is mature, the bees thin the cover of her cell by scooping out waved circles, till it becomes easy to distinguish the royal nymph within. She is generally retained prisoner by her subjects for some days after she has reached her full development. This is more frequently the case when the queens are reared for swarming time than when they are made by the bees in order to supply a deficiency.

The captive queen seems very impatient of her detention. She utters a cry, called by apiarians piping. The workers supply her with honey by means of a small hole in the cap of the cell, through which she extends her proboscis to be fed. Many observers, and among them some of the most accurate and faithful, say that the worker bees stand with their heads inclined, as if in reverence, while this note is sounding.

The moment a queen is released her whole energy is concentrated upon one point. She traverses the comb eagerly seeking for other royal cells. When she finds one, she falls upon it in fury, tears away the cover, and stings the nymph within to death. In this way she destroys every possible rival to her own power within the hive.

The bees generally provide against the simultaneous emergence, of the several queens which they rear, by selecting larvæ in different stages of development. Occasionally, however, two queens come out at once. They soon meet as they wander over the comb in search of royal cells. When this is the case, the workers, who under every other combination of circumstances defend their queens with their very lives, draw back, clear a space, and watch to see the result of the royal combat. The two queens rush upon each other, they grapple, and each endeavours to sting her antagonist fatally. If they happen to get into such a position that the thrust of the stings would prove fatal to both at the same time, their instinct teaches them to withdraw; the hive must not again be left queenless; private animosity must yield in favor of the public weal. They, however, soon rush again at each other. Finally one or the other gains such an advantage that she can destroy her rival without forfeiting her own life, and then the fatal thrust is given. It was long believed that the queen, like the drones, possessed no sting, because she will allow herself to be torn limb from limb rather than use it on any but a royal antagonist.

The peculiar treatment by means of which the larva of a worker is converted into a queen is, as far as we at present know, without a parallel in the annals of natural history. A difference of food, in kind and amount, increased room, and possibly a change of position, to which the embryo insect is subjected, has wrought a transformation almost too wonderful for belief. It is not a mere superficial change which has been effected, but one which penetrates far below form and structure, to the very mystery of life itself; it is a transformation alike of function, of structure, and of instinct. The larva which, under the ordinary conditions of development would have become a worker, which would have gathered the provisions and stored them, which would have defended the hive and guarded it, which would have reared the young, and performed the thousand domestic, civil, and military offices of the common hive, is converted into a queen who does not possess a single habit in common with the workers. The whole structure of the insect is also changed. The head, instead of being triangular, is round, the legs lose the pollen baskets and brushes, and the ovaries, which in the common bee are rudimentary, become enormously developed. The instincts are not only changed, out in many cases are reversed by this difference of treatment. The worker goes out of the hive many times every day, the queen but twice in her life. The worker is ready to sting anything which interferes with it, but never under any circumstances uses its sting upon a queen; the queen will die sooner than use its sting upon any ordinary foe, but will fly in fury upon another queen and thrust her through. The maternal instincts belonging to the brute creation are curiously divided between the workers and the queen. As mother the sovereign carefully deposits her eggs where they will have the best chance of coming to maturity; here her care ceases. Just at this point the workers take up the maternal duties, and they perform them with a zeal and devotion worthy of all praise. Increased room and two days' feeding on different food have wrought this miracle. It is remarkable, too, that the queens require four days less to develop, and live six or eight times longer than the workers.

Among the workers of a swarm there are found here and there, a few which are fertile. In the cases where investigation has been possible, it is found that these workers, when larvæ, occupied cells adjacent to the royal cell, and so, it is probable, partook of the royal jelly and became partially transformed. They have bodies which are longer and slenderer than common bees, and which approximate more nearly to those of the queen. They never lay anything but drone eggs.

Before swarming time several queens are reared (in this case on the edge of the comb, and frequently they depend from it by a sort of stem). It is not by any means true that swarming takes place always in consequence of the overcrowding of the hive. It seems to be closely connected with extreme heat, whether as cause or effect has not been very satisfactorily ascertained. A number of royal cells have been constructed, so that when the old queen leads off the swarm a new one may be ready to emerge and take her place in the old hive. The queen wanders over the comb in a restless way; her agitation is communicated to the other bees; a commotion arises; the bees gorge themselves with honey, send out a few scouts to discover a secure place for the swarm, and finally pour out of the entrance in a steadily increasing stream. Among them is the queen, who generally rises, and the workers cluster around her. Sometimes she falls and is lost in the grass, and then the bees return to the hive from which they have just issued. An inverted hive is held below the cluster of bees, which have happily found their queen and settled around her. As many as thirty swarms have come from a single stock in one season; some of these, however, were in the second generation.

Usually the fertilization of the queen takes place in June; after this, early in July, there is a general massacre of the drones. When there is no queen, or only a drone laying queen, in the hive, this slaughter is deferred. The bees fall upon the defenseless drones, pierce through their abdominal rings with their little barbed and poisoned darts, and then twist themselves over in order to extricate the sting without injury to themselves.

The sanitary regulations of the hive are very wonderful; nothing uncleanly or offensive is ever allowed to remain which it is within their power to remove. Réaumur mentions that a snail once invaded one of his observing hives and attached itself to a pane of glass. The weight of the creature was too great for even bee industry and enterprise, but not too much for bee ingenuity. They fastened the shell securely to the glass by means of propolis, and then sealed over the mouth of the shell with a quantity of the same gum. A slug which was once caught in one of Maralde's hives met a similar fate, except that, in this case, the whole body of the creature was entombed in the propolis.

This same substance is used to exclude every enemy of the insect tribe, as well as moisture and draft. The bees know very well that currents of air are desirable and drafts treacherous. While they cut off every avenue for the entrance of air where it would make them liable to disease, they supply a steady ventilation where it is needed. Lines of workers station themselves radially from the door to every portion of the hive: by a constant and well timed motion of their wings, steady currents of air are generated, which keep the hive pure and sweet. The force of the current is sufficient to turn small anemometers.

A guard is always stationed at the door of the hive to exclude enemies. The insects inside assume that the guards have done their work properly; for after robber bees or any other intruders have found their way in, it is generally long before any notice is taken of them. Occasionally a large moth, the *sphinx atropos*, or death's head moth, effects an entrance (Figs. 12 and 13) in spite of the vigilance of the guard. Once inside, the ravages of this creature are terrible. On dissecting one a tablespoonful of honey was found in its stomach. A very curious instance of transmitted intelligence is recorded of a swarm of bees, in connection with this foe of theirs. One of these moths had committed a serious raid upon the winter store of the swarm before it was discovered; several years afterward another member of the same family of moths entered the same hive; the bees at once took measures to secure themselves; the moth was excluded; barriers of wax were erected so that the door would not admit it, though the opening was still large enough for the bees themselves. The tradition of this Goth had evidently been handed down: they knew all about him the second time he came. Several generations of workers had been born and had died in the meantime, for the workers live only from five to seven months at the furthest. The ordinary bee moth is a terrible enemy to the hive, and does much greater damage than the sphinx, because its attacks are so much more insidious, and because it not only devours the honey, but the brood as well.

Bees are pugnacious little creatures, if roused by any fancied wrong or by the very human vice of cupidity. They are not disposed to sting if let alone, but are sure to revenge any hurt or indignity. Whole swarms often engage in pitched battles; this is almost always for the possession of territory. One piece of carelessness on the part of a bee keeper, and a whole swarm is sometimes demoralized; if they once gain access to honey, and can steal it, they are very apt to abandon all pretense of honesty, and give them selves up to a predatory life. Some of them, as has been before said, are professional sneak thieves; others are highwaymen. Huber and other apiarians mention the shameless behavior of some of these highway robbers. One of them will arrest a luckless humble bee on its way home laden with honey, and force it to disgorge its treasure. Violence will not do here, for the humble bee's honey pocket is far beyond the reach of our little thief. He does not kill his victim, but only calls "stand and deliver at the peril of your life," and generally succeeds in exacting that for which he asks. When the humble bee yields and gives up its honey, the bee allows it to depart in peace, and licks up the sweets with great gusto.

Our little honey bees, with all their wisdom and virtue, have their faults; and robbery, wholesale and otherwise, is not the only one. They sometimes make themselves thoroughly drunk on the juices of ripe fruits, and may be seen lying on the ground in a state of intoxication.

There are some things in the history of the honey bee which show a fidelity and devotion that is really touching. There is something almost human in their loyalty toward their sovereigns. Several instances are upon record where bees watched over and guarded the remains of their queen for days, licking and caressing her as though they were trying to restore her to life. Though food was supplied they refused to eat, and at the end of four days every bee was dead.

When a queen makes a royal progress through the hive she is always attended by a body guard, not a particular number of bees which are devoted to her person, but a body guard which forms itself at her approach out of the subjects through whom she is about to pass, but who fall back into their regular work when she has gone by. She never lacks the most dutiful and devoted attention; those about her, whenever she moves, caress her, offer her honey, and cluster around her to keep her warm if she is chill.

When a swarm loses a queen, they are at first in deep and violent grief; if a new queen is immediately given to them, they refuse to accept her. If, however, twenty-four hours is allowed to elapse, they reconcile themselves to the idea of her loss, and receive a substitute with royal honors.

The instinct of the bee denies all our traditions of instinct; it adapts itself to circumstances, overcomes new and unexpected obstacles, benefits by experience, employs temporary expedients, and then casts them aside when the occasion for their use is gone, in a way which is marvelously like reason. It is, indeed, difficult to draw any line between the two qualities when looked at in minute detail; it is only in its cumulative power, which produces such different effects, that we can dare to make the distinction, and then we are still at a loss for a definition. It is strange to find in the insect world, among an order of beings so low in the scale of the naturalist, a faculty so nearly akin to the divine gift of reason which is man's crowning glory. But it is just here, among the bees and among the ants, that it is most marvelous and most perfect.

NEW BOOKS AND PUBLICATIONS.

HAY FEVER OR SUMMER CATARRH; its Nature and Treatment. By George M. Beard, A. M., M. D. New York city: Harper & Brothers, Franklin Square.

The theory held in this work, relative to the very distressing malady to which it is devoted, is that the disease is a complex resultant of a nervous system especially sensitive in this direction, acted upon by the enervating influences of heat, and by any one or several of a large number of vegetable and other irritants. The book is the direct result of the author's practical investigation, and it deals with its subject with a thoroughness and care which the serious nature of the ailment has long demanded. Although, from the nature of the disease, no specific will likely ever be found for it which will meet every case, yet remedies almost approaching specifics have already been found for individual cases; and there are but few cases that cannot obtain more or less relief from some one of the many remedies that have been tested and laid down in this work.

MANUAL OF THE VERTEBRATES OF THE NORTHERN UNITED STATES, including the District East of the Mississippi and North of North Carolina and Tennessee. By David Starr Jordan, M.S., M.D., etc. Price $2.00. Chicago, Ill.: Janson, McClurg, & Co., 117 & 119 State street.

This is an excellent catalogue of the vertebrates of the principal part of this country. The definitions are especially clear and accurate, and the classification is such as to afford the greatest facility in identifying species. The information is thoroughly and judiciously condensed, so that the book, although dealing exhaustively with a very widely extended subject, is convenient in size, and may be carried by the tourist, to whom, if he have a taste for natural history, it will be especially valuable.

HANDBOOK OF MODERN STEAM FIRE ENGINES, including the Running, Care, and Management of Steam Fire Engines and Fire Pumps. With Illustrations. By Stephen Roper, Engineer, Author of "Handbook of Land and Marine Engines," etc. Price $3.50. Philadelphia, Pa.: Claxton, Remsen, & Haffelfinger, 624 to 628 Market street.

This book is claimed, by its author, to be the only one treating its special subject thoroughly; and he has succeeded in compiling a handy volume on the subject. He states, with becoming candor, that "its value to the class of men for whom it is intended, lies not so much in its originality as in the judicious selection, arrangement, and presentation of the matter it contains;" to which might well be added the authorization of such selections by giving due credit to the sources whence they are derived. The volume, which is in neat, pocket book form, is compendious and well arranged, and will be useful to any member of a fire brigade who desires to understand the science of his machine.

USEFUL TABLES AND INFORMATION APPERTAINING TO THE USE OF WROUGHT IRON, for Engineers, Architects, and Builders. Compiled by A. G. Haumann, C. E. Price $1.50. Pittsburgh, Pa.: Carnegie, Brothers, & Co.

These tables are among the best we have ever seen, and comprise calculations of the weights of iron beams of all forms of cross section, and the comparative strengths of cast and wrought iron of all sizes. Some extensive mensuration tables are given in addition, and also formulæ for bridges and roofs, the latter being founded on the writings of Professor Rankine. It is altogether a thoroughly trustworthy handbook, and deserves a large sale.

THE TEXTILE COLORIST, a Monthly Journal of Bleaching, Printing, Dyeing, etc. Edited by Charles O'Neill, F.C.S., etc. New York city: John Wiley & Son, 15 Astor place.

We are pushing England very hard in the manufacture of colored textile abrics; and we are now enabled to learn how many of her best designs and most effective colors are produced. The monthly magazine before us contains complete treatises on various methods of dyeing and producing variegated effects as practised in the best factories in England, the explanations being illustrated by pieces of fabric attached to the page. Though only

serial, the "Textile Colorist" is handsomely printed in book form, and will, when bound in volumes, form an encyclopædia of the very interesting art-manufacture of which it treats.

THE FATIGUE OF METALS UNDER REPEATED STRAINS. From the German of Professor Ludwig Spangenburg. Price 50 cents. New York city; D. Van Nostrand, 23 Murray and 27 Warren street.

This is an excellent treatise on a subject which has been much experimented on and discussed in this country. It forms No. 23 of Mr. Van Nostrand's "Science Series."

THE FRENCH METRIC SYSTEM OF WEIGHTS AND MEASURES, ETC. By John W. Nystrom, C.E. Price, free by mail, 50 cents. Philadelphia, Pa.: Pennington & Son, 127 South Seventh street.

This little work is a complete summary of all the arguments, *pro* and *con*, on the subject of the introduction of the metric system into English-speaking nations. Many of the objections seem trivial at first; but when considered in relation to the tens of millions of people who are asked to adopt the system, their importance is readily seen.

TABLE OF MECHANICAL MOTIONS. By W. Clark, C.E. London, England: 53 Chancery Lane.

Some useful diagrams, arranged to fill a sheet folded in a pocket case.

DECISIONS OF THE COURTS.

United States Circuit Court—Southern District of New York.

CORSET LOOM.—HUGO CARSTAEDT *vs.* THE UNITED STATES CORSET COMPANY.

Shipman, J:

This court passed a decree on September 10, 1875, enjoining the United States Corset Company from further infringement of the second claim of reissued letters patent granted to the plaintiff on November 19, 1872, for "an improvement in the take-up mechanism for looms for weaving irregular fabrics."

The plaintiff has now brought a motion for an attachment against James Lyall, one of the officers of said company, for violating the injunction which was issued upon said decree.

The portion of the patent improvement which is referred to in the second claim, consisted, as stated in the specification—

In a series of needles or points arranged upon a stationary bar in such relation to the take-up rollers that the fabric is continually carried across said needles, to be received by their points, and to be arrested when a reverse motion of any parts of the fabric is commenced.

The mechanism is thus described:

K is a cross bar immediately behind the roller, C, and provided with a series of needles, *k k*, in its lower edge, which catch in the goods and prevent its being drawn backward, under any circumstances, when the take-up mechanism releases it.

The second claim is for—

The needles or points *k k*, fixed in a stationary bar, and arranged as specified, so that the fabric being drawn by the take-up proper is continually carried across the needles to be received by their points, and to be arrested when a reverse movement of any part of said fabric is commenced, substantially as herein set forth.

The result of this improvement, which, it is said, in the opinion of the court upon the final hearing, was "the arresting of the fabric when it is released from the tension of the take-up, and so holding the cloth that it is prevented from doubling up in the center," was previously unattained in corset weaving.

The defendants have modified their needle bar since the injunction was issued, so that it now consists of a number of small independent needle rollers mounted upon a fixed shaft, which runs across the width of the cloth in the same position and relation to the take-up which the shaft had before.

Each of these rollers rotates forward toward the take-up, or in the direction of the cloth when the cloth is being moved forward and taken up by the take-up mechanism, but the rollers are prevented from moving backward when the reed recedes and the tension of the take-up is relaxed by a ratchet and pawl applied to each roller. Each roller then becomes stationary, arrests the fabric when a reverse movement has commenced, and prevents the cloth from being drawn back when the take-up mechanism has released it. When the reed moves forward and delivers its blow, the cloth is easily pulled over the rotating roller by the take-up; when the reed goes backward, the rollers are fastened by the ratchet and pawl, become stationary, catch the cloth upon the needle points, and hold it so that it will not double up.

It is contended that such a needle bar is not a stationary bar, and therefore it is not embraced within the second claim of the patent. It is a rotary bar when a stationary bar is not needed; but when one is needed, it is the same stationary bar which was previously upon both plaintiff's and defendant's machines, and accomplished the same practical result.

The needle points of the former needle bar were inclined toward the take-up, so that when the cloth was moving forward it was carried across the needles, and when it was released from the take-up the cloth was arrested upon the needle points. The new roller of the defendants, when it is rotating in one direction, permits the cloth to go forward without detention; but when a reverse action commences, the roller immediately becomes stationary, and the needle points catch and hold the cloth precisely as the old stationary bar accomplished the result.

Neither bar assists the take-up mechanism in pulling forward or taking up the cloth in any material degree, and the roller of the defendent becomes a stationary bar whenever stability is required

The rotating character of the new needle bar is said to be an improvement upon the plaintiff's fixed bar. I think that this is true, and that the revolution of the roller with the forward movement of the cloth avoids any danger of the cloth being caught upon the needle points as it is drawn forward. But the fact that the new bar is a better one than the plaintiff's, or even performs a service which the plaintiff's bar does not perform, does not prevent the new device from being an infringement; it performs the same office which the old device performed by the same mechanical means. An infringing device is not protected by the fact that, although the device "was an equivalent of patented device in all its functions, and in its construction and mode of operation, yet by other or additional features it possessed other and further useful functions. Such a device would, perhaps, be an improvement upon the patented device, but must be, nevertheless, deemed an appropriation of the former. *Sarven* vs. *Hall*, (9 Blatchford, C. C. R., 524).

My conclusion is that the needle bar is an ingenious attempt to escape from the second claim of the patent, and that the motion of the plaintiff must be granted. As the defendant acted under competent advice, and had no intention of disobeying the order of the court, no fine is imposed, but he is ordered to pay the cost of the application and of the affidavits.

[*J. Van Santvoord*, for plaintiff.
George Gifford, for defendant.]

United States Circuit Court—District of Massachusetts.

BOOT HEEL POLISHING MACHINE.—DAVID H. SWEETSER, TRUSTEE, *vs.* CHARLES H. HELMS *et al.*

Shepley, J:

The bill in this case charges infringements of three patents—one to Elias S. Ingalls, dated May 8, 1860, for "improvements in machines for burnishing the edge of the sole and heel of boots and shoes," one to Benjamin Q. Budding, dated August 8, 1863, for "improved heel-polishing machine," and one to Benjamin Q. Budding, dated May 3, 1864, for "improved machine for polishing the heels of boots and shoes."

These patents all relate to a class of machines for polishing the edges of the heels and soles of boots and shoes, in which there is a combination of certain mechanism for holding the sole or heel (or both) to be polished with the mechanism of the polishing tool, under such conditions of mechanical combination that either the holding mechanism, with the material held, can be so moved as to bring the surface to be polished in proper relations to the polishing tool, or the polishing tool can be so operated as to bring it into proper relations with the surface to be polished of the material held by the holding mechanism.

The Helms machine, alleged to be an infringement, differs from these machines in this essential feature. There is no attempt in the Helms machine to so combine a shoe-holding mechanism with the polishing-tool and its mechanism that the two will operate properly together. On the contrary, in the Helms machine the shoe-holding mechanism is dispensed with, and the operator puts the shoe into proper relations with the polishing tool, and holds, and keeps and guides it there, by and with his own muscular strength and will. There is no shoe-holding mechanism which is made to travel in a fixed path in relation to the polishing tool, nor any polishing tool made to travel in any fixed path in combination with or in any relation to a shoe-holding mechanism.

This radical difference between the two classes of machines is fatal to the claim of infringement, and renders unnecessary a consideration of the other questions presented at the argument of the case.

Bill dismissed.

[*Thomas L. Livermore*, for complainant.
James E. Maynadier, for defendant.]

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From June 13 to June 26, 1876, inclusive.

ADJUSTING WRENCH.—E. K. Knight, Philadelphia, Pa.
CARRIAGE WHEEL.—R. W. Davis *et al.*, New York city.
COMPASS CARDS, ETC.—E. S. Ritchie, Brookline, Mass.
ENAMELING IRON.—F. G. Niedringhaus *et al.*, St. Louis, Mo.
FASTENING BAG MOUTHS.—J. E. Walsh *et al.*, New York city.
FOLDING PAPER, ETC.—L. C. Crowell, Boston, Mass.
FOLDING SEAT, ETC.—C. A. Hardy, Philadelphia, Pa.
FRICTION CLUTCH, ETC.—C. H. Addyman, New York city.
GAS FURNACE, ETC.—F. Carroll, New Orleans, La.
GEAR WHEEL.—J. Comly, Lincoln Park, N. S.
HAT BODY.—A. Freshfield, New York city.
HEATING BUILDINGS, ETC.—E. S. Jenison, Chicago, Ill.
HYDROSTATIC PRESS, ETC.—J. W. Hyatt *et al.*, Newark, N. J.
LIQUID METER.—D. W. Huntingdon *et al.*, South Coventry, Conn.
MARINE GOVERNOR.—C. Steele, New York city.
MOLDING IN WAX, ETC.—C. Grasser, Somerville, Mass.
PARQUET FLOORING.—S. P. Groocock, New York city.
PIPE COUPLING, ETC.—E. A. Leland, New York city.
PREPARING BONE BLACK, ETC.—O. Lugo, New York city, *et al.*
REFRIGERATOR.—D. W. C. Smiley, Brooklyn, N. Y.
SEWING BOOKS WITH WIRE, ETC.—H. R. Heyl, Philadelphia, Pa.
SHAPING METAL, ETC.—W. Sellers *et al.*, Philadelphia, Pa.
SMELLING BOTTLE.—H. Warner, Boston, Mass.
SPEED INDICATOR, ETC.—C. Neer, Brooklyn, N. Y.
STATION INDICATOR.—C. A. Evans, Upland, Pa.
STOVE.—H. L. McAvoy, Baltimore, Md.
TOY FIGURES.—L. Schmetzer (of Chicago, Ill.), Rothenburg, Bavaria.
WEFT KNITTING LOOM.—C. L. Spencer, Providence, R. I.
WOOD PAVEMENT.—B. F. Pond, Brooklyn, N. Y.

Recent American and Foreign Patents.

NEW AGRICULTURAL INVENTIONS.

IMPROVED BUCKWHEAT CLEANER.

Harker R. Ward, Loveton, Pa.—This consists of a horizontal concave and cylinder, respectively armed with spirally arranged strips of clothing thereon. The essential function of the machine is to act upon the grain after it has been treated by the hulling stones, to detach the matters not removed from the grains by the stones.

IMPROVED COMBINED PLOW AND CULTIVATOR.

Charles Frank, Freeburg, Ill.—This embodies several new mechanical devices whereby the machine may be readily adjusted for use as a plow or as a cultivator, and which can be conveniently manipulated. These devices enable the frame to be raised or lowered so that the plows may work at any depth, allow of the plows and cultivators to be easily attached or detached, and permit of the tongue being adjustably secured to the frame.

IMPROVED STRAW CUTTER.

Alexander Anderson, London, Canada.—This relates to a straw cutter in which the cutting box is arranged obliquely to the plane in which the cutter works; and it consists in the combination of a gage with a vertically sliding cutter and diagonal feed box, for regulating the feeding of the hay and straw to the cutter. The said gage is so mounted and connected with the cutter that it moves out of the way of the cut material to allow it freedom for escape when the cutter acts, and moves back in time to perform its function when the cutter rises. It is also fixed adjustably to gage the material longer or shorter, as desired.

IMPROVED REVOLVING HARROW AND PULVERIZER.

Thomas A. Kershner, Seymour, assignor to himself and Alexander Carr, Medora, Ind.—The new feature consists in the teeth made with curved forward edges, concaved rear edges, and broad heads pointed to the rearward, in combination with a rotating cylinder.

IMPROVED MILK COOLER.

William Eaton and John A. Randall, Norwich, N. Y.—This is a double milk pan, consisting of two milk compartments, separated by an intermediate cooling chamber, extended longitudinally between them.

IMPROVED CURCULIO CATCHERS.

Evlyn T. Hull and Edward Hollister, Alton, Ill., administrators of Edwin S. Hull, deceased.—This is a frame made with jointed and adjustable arms and covered with muslin. It encircles the trunk of the tree and catches the insects which are shaken down upon it, the insects afterwards being swept into suitable pockets.

IMPROVED GATE.

Edward A. Shugart, Athens, Tenn.—This is so constructed that it may be easily opened and closed, may be secured in place when opened to any desired extent, cannot be raised or pushed open by stock, and will shut itself when released.

IMPROVED GATE.

John A. H. Wilson, Deer Creek, Ill.—The operation is as follows: Any one approaching the gateway from either direction, and desiring to pass through it, will seize a cord, and by pulling it will move levers to raise the outer end of the gate over the shoulder of a tilting rail. The inner end of the rail itself is simultaneously raised. The gate is then caused to run along the rail by the operation of gravity until it is arrested by a post.

IMPROVED HARROW.

James Elliott, Jefferson, Wis.—This consists of a number of toothed harrow sections that are connected by pivoted side pieces, and made to slant by slotted angular braces and clamp bolts. The harrow sections are coupled latterly by interlocking hook devices.

IMPROVED CULTIVATOR.

Daniel F. Vickery, Oxford, Ala.—This invention is an improvement in that class of walking cultivators whose shares or teeth are made adjustable toward and from each other laterally. The improvement relates particularly to the construction and arrangement of parts whereby the shares or teeth are made laterally adjustable, separately or together, without changing their relation to the line of draft. The teeth are attached to a horizontal bar pivoted to the beam and provided with curved braces for regulating its adjustment.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED STENCIL PLATE.

David P. Lake, Helena, Montana Ter.—This is an improved stencil frame, that is adjustable to letters of different sizes and to any number of lines. It is made of lateral clamping plates, slotted and pivoted side guide pieces, and clamp screws.

IMPROVED HORSE-DETACHING DEVICE.

John V. Ericson, Escanawba, Mich., assignor to himself and George English, same place.—This is an improved device for detaching horses from the wagon or carriage in case of danger, which device causes also the carriage to run in straight direction after the horses are detached to prevent upsetting. The invention consists of the shaft bar, that is locked to the axle by swinging fingers and clips, and a central yoke part, which is retained by a stop pin until released by a connecting rod. The pin-carrying arm is fulcrumed to the reach, and extended below the same to lock into the notched or toothed fifth wheel of the carriage. The pin arm acts thereby as a pawl or stop to the fifth wheel, and produces the locking of the same, and consequently the forward motion of the carriage in straight direction.

IMPROVED FEED BAG FOR ANIMALS.

Thomas Miller, Jersey City, N. J.—This consists of a secondary bag inside of the ordinary bag, with a spring between its bottom and the bottom of the outside bag, so contrived that the spring, which is contracted by the weight of the food placed on it, will rise as the food is consumed, and thus the level of the food will be maintained in convenient proximity to the mouth of the animal.

IMPROVED DINNER PAIL.

Otto Cæsar, New York city.—This consists of a dinner pail with a recessed bottom and a heating attachment that may be lowered to form a support for the pail, and replaced and stored at the inside of the pail after use.

IMPROVED CARPET RAG LOOPER.

Charles F. Gronquist, Genoa, Ill.—This is a contrivance of a knife for slitting the rags to be looped together, with a hole in it, through which a looping hook is caused to project over the rags when pressed down on it, for making the slits, to pull the free end of the rag through the hole previous to the escape of the slitted ends from the knife, so that when the slits pass off they draw over the end of the rag passing through the cutter, forming a loop, which is tightened up by catching hold of the rag by the thumb and finger, and drawing it up taut in the slits.

IMPROVED DOLL SUPPORTER.

Mrs. E. C. McCutchins, Washington, D. C.—This invention consists of a metallic ring or girdle, to surround the waist of the doll, attached to legs made of stout wire, with their lower ends bent outward and flattened to form feet. The girdle is closed by a string or pin passing through holes in its end, and is provided with an upright back piece or support on its rear portion, through holes in which strings run and tie over the breast of the doll.

IMPROVED BOOT AND SHOE.

David J. Rogers, Bardstown, Ky.—This invention is an improvement in the class of boots and shoes provided with wooden soles, and relates particularly to the mode of securing the wooden heel, and also the rear edge of the wooden sole, to the leather sole, by screws, in such a manner that the screws are concealed and prevented from tearing out of or wearing the sole.

IMPROVED FOUNTAIN PEN.

Henry N. Hamilton, White Plains, N. Y.—The lower end of a tube, which serves as a socket to receive the handle, is halved and closed with a plate, which is extended into a tongue. The lower part of the tongue fits into the hollow of an ordinary pen, and forms a chamber to receive and hold the ink. The tongue is perforated with numerous holes, into which the ink enters, so that the ink may be partly supported by capillary attraction, and thus rendered less liable to run out too rapidly. The pen may be readily removed from and inserted in the holder by sliding down a ring.

IMPROVED FAUCET.

Minrad Obermiller, Toledo, Ohio.—This relates to a pump attached to a faucet, contrived in such a manner that when the faucet is opened it forces air into the barrel, either through the faucet or a tap fitted in the barrel.

IMPROVED ARTIFICIAL TEETH.

Merrick Bemis, New London, Conn.—The object of this invention it to furnish sets of teeth for eating purposes for those whose front teeth remain good, which will enable them to thoroughly masticate their food, and, at the same time, will avoid the necessity of having the remaining teeth drawn. It consists in artificial teeth in which the plates are formed to fit over the natural teeth, and in which the teeth are all molars, and are arranged with the longer side inward.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED CAR SPITTOON.

James H. Quackenbush, Kalkaska, Mich.—This consists of an outer tube with rim of inverted conical shape, an intermediate layer of suitable paper, closed at the bottom, and an interior tube with corresponding and overlapping top rim, the whole to be seated into a perforation or seat of the car floor. The device keeps the car clean, and may be easily cleansed and kept in order.

IMPROVED MACHINE FOR SAWING SHINGLES.

Erastus P. Kidder, New Alstead, N. H.—This consists of a carriage working vertically, and presenting the block to the under side of the saw, together with a tilting gage to regulate the thickness and taper, and a discharging chute, which the shingle being cut off pushes out of the way to pass by it, and which falls back to catch and discharge the shingle. By feeding the block upward to the saw, it can be held on the carriage without dogs, and is more convenient to manipulate on the carriage.

IMPROVED WHIFFLETREE HOOK.

Peter P. Kunz, Florence, Iowa.—The ferrule is cast with a solid outer end, and upon its forward side is a hook arm, in the cavity of which rests the end of a bar. The bar is bent at right angles, and its other arm passes through a hole in the ferrule at the end of the whiffletree. Upon the bar, within the cavity of the ferrule, is placed a spiral spring, by which it is pressed forward against the hook, so that the tug or cock eye placed upon the said bar cannot become accidently detached. The tug is attached and detached by pressing the bar to the rearward and turning its free end upward.

IMPROVED VENTILATING CAR.

Cornelius G. Van Pappelendam, Charleston, Iowa.—This consists of a contrivance of a system of pipes in the upper portion of the car to take out the vitiated air by the draft caused by the motion of the car. There is also an arrangement of pipes with a hood on the top, for catching the air and conducting it down along a heater, in cold weather, to a conductor along the floor and below it, the floor being perforated to allow the air to rise into the car.

IMPROVED LOG TRACK.

Jewit N. Russell, Augusta, Wis.—This is a track for hauling logs, by which, it is claimed, they may be transported in cheaper and quicker manner than by the use of sleds, wagons, or tramways. It consists of a track made of longitudinally jointed sleepers, with lateral braces, revolving rollers, and side guards. The logs are coupled and drawn or pushed uphill and over the levels by horses walking at both sides of the track, being allowed to move downhill by merely letting them go.

IMPROVED SHINGLING BRACKET.

Stephen N. Chapman, Moodus, Conn.—This is a bracket clamp or stay for the purpose of putting up stagings on shingled roofs. It consists of a clasp piece that is slipped on the butt of the shingle, and fastened by a supporting arm with an eccentric spur locking thereto. The bent-up end of the supporting arm rests on the roof and supports the staging.

IMPROVED SAW GUMMER.

Jason W. Mixter, Templeton, Mass.—This consists in improvements in saw gumming machines so that they may be readily set to any angle of cutting in connection with a feed that may be controlled either automatically or by hand, as desired.

IMPROVED WOODEN HOOP FASTENING.

Wilbur J. Squire, East Haddam, Conn.—This consists in a wooden hoop having its ends locked by a band drawn into a notch at each end. It seems to be a very simple and useful device.

IMPROVED MACHINE FOR BORING FENCE POSTS.

John Dickens, Kingston, N. J., assignor to himself and George R. Kelly, same place.—The novel feature in this is found in the carriage, which is secured in place by a clamp bar, through the center of which a screw passes, and is swiveled to the table, and has a hand wheel attached to its lower end, below the said table. The clamp bar moves up and down upon guide pins, and upon its under side are formed points, which enter holes in the bars of the carriage to center said carriage when adjusting it.

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For Sale Cheap—2 Gardner's Centering & Squaring Attachments for Lathes. Jackson & Tyler, Balt., Md.

Dynamo-Electric Machines for electro-plating and other purposes. Send for illustrated circular. W. Hochhausen, 132 William St., New York.

"Abbe" Bolt Forging Machines and Palmer Power Hammers a specialty. Send for reduced price lists. H. Forsaith & Co., Manchester, N. H.

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The Target Air Pistol kills cats, rabbits, squirrels, pheasants, pigeons, and other small game. Mailed, post paid, for $3.78. Send stamp for circular and testimonials. E. H. Hawley, 130 George St., New Haven, Ct.

For Sale—An improved Daniels Planer, in good order. Address F. A. Sinclair, Mottville, N. Y.

New Mechanical Movement for Sale, very cheap. Diploma of Am. Inst. W. H. Benson, Waynesboro, Va.

Driving Belts made to order, to accomplish work required. Send full particulars for prices to C. W. Arny, 148 North Third St., Philadelphia, Pa.

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Scientific American—The early Volumes for Sale—very cheap—either bound or in numbers. Address A. F. B., Box 773, New York City.

Hydrant Hose, Pipes, and Couplings. Send for prices to Bailey, Farrell & Co., Pittsburgh, Pa.

Machine-cut brass gear wheels, for models, &c. List free. D. Gilbert & Son, 212 Chester St., Phila., Pa.

"Dead Stroke" Power Hammers—recently greatly improved, increasing cost over 10 per cent. Prices reduced over 20 per cent. Hull & Belden Co., Danbury, Ct.

Power & Foot Presses & all Fruit-can Tools. Ferracute Wks., Bridgeton, N.J. & C. 27, Mchy. Hall, Cent'l.

Shingles and Heading Sawing Machine. See advertisement of Trevor & Co., Lockport, N. Y.

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Notes & Queries

H. F. is informed that the metal manganese is mixed with copper to make manganese bronze. —S. O.K. should stuff his saddles with well cleaned wool.—T. J. L. will find directions for ridding his house of water bugs on p. 315, vol. 32.—F. W. S. is referred to our advertising columns for a good system of short hand.—L. N. will find a recipe for aquarium cement on p. 80, vol. 31.—J. T. M.'s questions as to the first year, etc., are absurd.—B. B. will find directions for cultivating mushrooms on p. 129, vol. 34.—W. R. K. can waterproof paper by the process described on p. 17, vol. 33.—E. T. C. will find directions for polishing brass instruments on p. 57, vol. 34.—H.H. is informed that the only import duties in England are on tea, tobacco, and alcohol in all its forms. A few duties are put on silver plate, playing cards, etc., to compensate for the internal taxation on these articles.—D.H. can get rid of ants by applying the remedy given on p. 172, vol. 33.—W. A. W. will find the formula for the friction of water in pipes on p. 250, vol. 34. —H. F. L. will find a description of a pantagraph on p. 179, vol. 28.—H. W. will find some notes on boiler furnaces and bridge walls on p. 339, vol. 33. —J. S. will find a description of M. Jamin's magnet on p. 383, vol. 29.—A. J. D, is informed that the process of type founding is too complicated for description in these columns.—B. F. K. will find directions for making vulcanized rubber stamps on p. 155, vol. 31.—W. B. H.'s specimen of paper board is too hard to be penetrable by oil. It could be softened by soaking in hot water.—A. B. will find directions for preparing lime for oxyhydrogen light on p. 315, vol. 33.—W. J. B. will find directions for preserving eggs on p. 306, vol. 34.—C. B. R. will find a recipe for cement for cracks in stoves on p. 183, vol. 34. For bronzing iron castings, see p. 243, vol. 34.— D. B. T. will find formulæ for the pressure and temperature of gases on p. 123, vol. 33.—S. H. G. will find a good recipe for indelible ink on p. 129, vol. 28.—F. F. T. will find an answer to his query as to dynamometer brake on p. 273, vol. 31.—E. D. R. can fasten mother-of-pearl to glass with the cement described on p. 46, vol. 33.—E. O. T. will find several good recipes for bronzing on pp. 38, 243, 312, vol. 34.—S. S. D. will probably find that the oxyhydrogen light will answer his purpose.—G.H.F. will find directions for making gas for domestic use on p. 131, vol. 30. For gilding wood, see p. 90, vol. 30. A compound of pounded ice and salt makes an excellent freezing mixture.—R. can obtain a copy of a print in facsimile by the photo-engraving process advertised in our columns.—A. O. F. will find directions for making concrete pavements on p. 185, vol. 33.—C. F. S., H. S. U., G. W. S., J. L. B., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) W. U. L. asks: 1. Is it possible to run a band saw by foot power? A. Yes, for light work. 2. What speed does it require? A. The saw should run by foot power at about 4,000 feet per minute.—J. E. E., of Pa.

(2) N. F. C. asks: What is the matter with a telescope which "looks smoky," and does not give a sharp definition? A. Either the spherical aberration is not corrected or the glass is not homogeneous. The probabilities are that the center and edge are not of the same focal length. Take a piece of paper the size of the lens, cut a circular piece from the center one half its diameter, cover the marginal portion of the lens with the outer part of the paper, allowing the light to pass through only the central portion of the lens; focus on some well defined object, then put the central piece of the paper over the center of the lens and remove the other, and focus with the light passing only through the margin: thus, by using diaphragms of different sizes over different parts of the glass it can be seen whether all parts of the glass have the same focus; if not, the glass must be corrected accordingly.

(3) P. F. asks: Can I successfully transmit motion from one friction pulley, 6 inches in diameter, going at 4,000 revolutions per minute, to another pulley 4 feet in diameter, by bringing the large one in contact with the small one, by a hand lever? A. Yes, if the faces of the pulleys are grooved. See diagram No. 60, "Mechanical Movements," in SCIENTIFIC AMERICAN REFERENCE BOOK.

(4) J. B. L. says: My telescope is constructed according to a description given some three years ago in the SCIENTIFIC AMERICAN. The eye leys is plano-convex, and gives an inverted image. I wish to know if, by using a double concave eye lens which does not invert the image, I can get the same field. A. No, only about one third as much, with a lens of the same focal length.

(5) S. B. & Co. ask: What will remove grease from emery wheels without injury to the wheel? A, Bisulphide of carbon is the best known solvent for oil or grease. Naphtha and benzine are also good solvents.

(6) F. R. says: In p. 6, vol. 35 of the SCIENTIFIC AMERICAN, in giving the composition of sulphate of potassa, you use KO as the symbol of potassa and H O as the symbol of water, while according to Youman's "New Chemistry" K_2O is used as the symbol of potassa and H_2O is used as the symbol of water. These compounds (KO and HO) could not exist according to Youman's "Chemistry," as there would be an odd bond in the molecule, thus: K—O—, H—O—. Please explain. A. The symbols were given according to the old system of nomenclature, but the new system is for many reasons preferable. Whether the old or new system, however, be employed in calculating the percentage composition of compounds such as you mention, provided the systems are not confused with each other the final result will be the same. For instance: According to the old system, sulphate of potassa would be written KO,SO_3, while according to our present theory of chemistry is written K_2SO_4. While in the present system the atomic weight of potassium remains the same as in the old, those of oxygen and sulphur have been doubled:

	Old Theory.	New Theory.
Potassium (kalium)........	39·2	39·2
Sulphur......	16·0	32·0
Oxygen	8·0	16·0

As there enters into the composition of the above salt, according to the old formula, one atom of potassium, one of sulphur, and four of oxygen, and according to the new theory, two of potassium, one of sulphur, and four of oxygen, the composition by weight will be as follows:

Old.	New.
K 39·2×1=39·2	K 39·2×2=78·4
S 16·0×1=16·0	S 32·0×1=32·0
O 8·0×4=32·0	O 16·0×4=64·0
87·2	174·4

87·2 : 39·2 : : 100 : x, or 174·4 : 78·4 : : 100 : x. In these two proportions, x, or the amount of potassium as calculated from either of the above systems= 44·9541$\frac{31}{109}$. And as determined by like methods the proportions of the constituents of the salt in 100 parts by weight are S 18·3486 $\frac{26}{109}$, O 36·6972$\frac{52}{109}$.

(7) A. R. asks: Is there to be an occultation of Saturn by the moon on August 6? A. Yes, between 10·30 and 14.0 P. M., duration about 20 minutes. There will be another on September 3, commencing about 2.30 A. M. with a duration of 1 hour.

(8) W. G. ,F asks: What is the cause of mildew and blotches appearing on the fresco painting in a church? A. The roof may leak and wet the ceiling and walls slightly, or dampness may be generated under the floor, and the church may not be sufficiently ventilated during the week. A warm day and a cool night would occasion a precipitation of moisture on the interior of the walls, unless there were means of ventilation.

(9) M. W. asks: What is the weight of a cubic foot of solid ice? A. About 57½ lbs.

(10) R. S. asks: 1. Is there any substance that will prevent the oxidation of galvanized iron when used for water coolers, and the consequent taste thereby imparted to the water? A. Try the application of melted paraffin. The surfaces may be uniformly covered by means of a brush. Pure paraffin is both tasteless and inodorous, insoluble in water, and not attacked by either acid or alkaline solutions. 2. Is there any substitute for muriatic acid in soldering the same that will not discolor the iron or affect the water? A. Pulverized rosin is sometimes preferred for this purpose.

(11) C.B.Q. asks: Why is it that the sun, shining through small apertures of any irregular form, produces circular bright spots instead of spots of the shape of the aperture? A. The light from a bright object passing through a small aperture forms an image of that object. It is therefore an image of the sun and not of the aperture which is seen; and as the aperture is increased the image of the sun is less, and that of the aperture more, defined. Eclipses of the sun are sometimes observed by this means.

(12) L. C. M. asks. Will a vertical steam boiler 30 inches high by 16 inches diameter, with 12 upright flues, 1¾ inches in diameter, running the length of boiler, set on the lower half of a common coal stove, be of sufficient capacity to warm a house by hot water, the house containing 4 rooms, each 16 feet square by 9 feet high? A. If you have a strong draft, and a good arrangement of heating pipes, we think your boiler might answer.

(13) N. P. M. says: We desire to heat and ventilate a schoolhouse in the most efficient manner and at the least possible cost. The size is 25 feet by 38 feet, and 12 feet from floor to ceiling, with four windows on each side, and two doors in front end. The floor is about 1 foot from the ground. It is a frame building. A. If there is no cellar under the building, excavate a small one at the windward end and provide a good warm air furnace; supply air to the air chamber of the furnace from the exterior of the building by means of a long wooden box or shaft extending to the point where the most prevalent winds strike the house, and insert in said shaft a sliding board valve, to close it or limit its capacity at pleasure. Supply the warm air to the room by means of two large floor registers, one upon each side thereof, conveniently arranged for drying the feet. For the ventilation, place three vertical pipes of tin or wood, about 6 by 12 inches, on on either side, one between each two windows, and extending from the floor to the ceiling and discharging into the space above the ceiling, and provide two ventilating registers in each pipe, one near the floor and one near the ceiling; in cold weather, the lower one alone may remain open, in warm weather both. If your building has gables, place a window in each gable, filled in with blind slats so set as to effectually protect the interior from storms, and these will give the proper ventilation to the space between the ceiling and roof. If, however, you have a high roof, ventilate by a small cupola provided with windows of like description. As a matter of economy, your present stoves enclosed within brick walls may give you a very effective furnace. Be careful to see that the fire chambers are tight, so that no smoke or gas can escape to contaminate the air.

(14) G. D. S. asks: How can I destroy grass, weeds, etc., in gravel walks? A. Dig them up by the roots. Cutting off the tops does no good.

(15) E. T. C. asks: How can I prepare calf and sheep skins for drumheads? A. Remove the hair or wool from the skins by steeping in a solution of lime; then shave all the fleshy matter from the inside, wash, and stretch the skins tight on frames; rub well with pumicestone, polish with powdered chalk, and dry. Finish with a coating of white of egg.

(16) E. & D. ask: 1. How can we make colored printing ink? A. To make printing ink, old linseed oil, boiled and ignited, must be taken, and good black rosin selected. Soap is another important ingredient, yellow rosin soap being used for black ink, and white curd soap for the various colored inks. Vegetable lampblack is the best for making black ink. Boil 6 quarts linseed oil till the smoke begins to rise, and ignite the vapor with a bit of lighted paper in a cleft stick; let it burn till the oil, now transformed into a varnish, will draw out into strings half an inch long. Then 6 lbs. rosin should be gradually added, and then 1¾ lbs. soap in slices, which must be put in cautiously, as the water contained in it causes a commotion. Set the pot on the fire and stir well with a spatula. Put 8 lbs. of the pigment into an earthen pan, and add the varnish by slow degrees, and stir carefully till the whole is incorporated. Then grind in a mill or on a slab with a muller. The pigments commonly in use are carmine, the lakes, vermilion, red lead, Indian red, Venetian red, red, yellow, and orange chromes, burnt sienna, Prussian and Antwerp blues, etc.

(17) M. B. asks: How are potatoes desiccated and preserved? A. They can be cut in small cubes, or powdered on a grater, and dried in an oven.

(18) R. R. asks: 1. What is the composition used in rockets composed of? A. Mix together 12 parts (by weight) saltpeter, 6 parts charcoal, and 4 parts sulphur. The ingredients should be powdered separately. 2. How is golden fire made? A. If you mean golden rain for rockets, take meal powder 6 parts, saltpeter 1 part, charcoal 2 parts. Powder separately and mix.

(19) O. A. J. asks: In balancing a crank shaft for a steam engine running at high speed, should I put the combined weight of connecting rod, crosshead, and piston opposite the crank pin on the balance crank, or should any allowance be made for the lower end of the connecting rod resting on the crosshead? A. For a vertical engine, the first method is necessary. For an horizontal engine, balance the crank and two thirds the weight of the connecting rod.

(20) E. L. says: My house stands on level land. At the present time the water in my cellar is 30 inches deep, caused by the heavy rains. I have thought I would pump the water out when drier weather comes on, and then with a sledge hammer drive stones in the soft bottom, and cover the stones and sides of the wall with water lime cement, hoping thereby to have a good dry cellar. Do you think my method a good one, or will the upward pressure of the water burst up the cement? A. The upward pressure of the water will be equal to the weight of the water, according to the hight it would rise above the floor. At 30 inches deep the upward pressure would be a little more than 1 lb. per square inch, or 156¼ lbs. per square foot. To sustain this, you require a stone bottom about 10 inches thick, more or less, according to the weight of the stone. This should be laid in and grouted in cement, when the cellar is dry. For the sides, build up on the inside of your present cellar wall another lining wall as high as the water rises, and 12 inches thick, carefully laid up in the cement. If you wish to retain the present hight in the clear in the cellar, you must excavate to the depth required by the stone bottom. Use the best hydraulic cement, and grout it well into the joints of the stonework.

(21) H. L. C. says: Would a dam, 300 feet long and 15 feet in the middle, running out to nothing at the ends, and 2 feet thick at the top and 4 or 5 at the bottom, filled in with loose rocks and dirt (on the water side), be sufficiently strong to hold the water to make a pond for cutting ice? A. The weight of wall and backing would be sufficient to resist the pressure of the water; but the permanency of a dam depends mainly upon its capacity to retain the water without leakage. The wall should have a proper foundation deeply laid, and the interior slope made watertight with a clay puddling extended over the bottom of the pond for some distance in from the dam. The least discharge of water through or under the dam washes the earth away, and continually increases the size of the aperture, until it threatens the stability of the whole work.

(22) J. L. W. asks: 1. In building a heavy brick wall, which of the two makes the best and most secure job of brickwork, making every third or every sixth course of brick headers? A. Every third course is the stronger, although they are seldom laid so frequent as that. 2. In turning arches in a cell building for a prison, where one cell will be above the other for four stories high, should the centers that the arches are turned over remain in the first stories until the entire upper stories are completed? Will it damage the work to strike the centers when the first story is complete, so as to use the same in the next stories? A. The centers should be struck as soon as the mortar is well set, in order that the arch may come to its proper bearing, it being understood that the exterior walls of the building, where the last arches are received, are sufficiently thick and high to resist the thrust of the arches. 3. The cells are 5 by 8 feet, the arches are semi-circular, turned the 5 foot way. Should the ends of the arch, where they come in contact with the main walls, be built in solid, so as to tie them together, or should the arch be turned separately, merely finishing against the main wall? A. It is not necessary; the stability of the arches will depend upon the sufficiency of the final abutment at the termination of the series against the exterior wall at the two ends.

(23) E. O. K. says: 1. I am building a house, and wish to supply a range and bath tub by means of a tank in the attic over the kitchen. Is there any better way to make the tank than to build an outside frame of pine plank, and set inside it a watertight tank of zinc? A. The best kind of tank for your purpose is one formed of cast iron plates, 18 by 18 inches, and 9 by 18 inches, with exterior flanges at the joints through which the plates are bolted together. A tank 6 feet by 4½ feet and 2 feet 3 inches high would be a suitable size and could be made from these plates. The next best kind would be one made of 2 inch plank, tongued and grooved together, rectangular, the ends tongued into the sides, held together with frames of light timber, and lined with sheet lead. As for zinc it is too brittle, and is injured by the contraction and expansion which it has to undergo. 2. I wish to construct in my outdoor cistern such a filter as will render the water drinkable. How shall I best accomplish it? A. Make the crosswall of brick with openings at bottom, enclosing one third of cistern; fill in this space with a layer of sand, a layer of charcoal, and a top layer of sand, and the clear water will rise through it.

(24) J. M. B. asks: What is the compound used for penciling or tucking brick walls? A. White lime mortar, consisting of pure lime paste and a little white sand.

(25) J. A. G. asks: Which is the best for grinding a turning or planer tool on, an emery wheel or a grindstone? A. A grindstone is the best.

(26) J. E. L. asks: How many revolutions per minute, and what particular way of filing a circular saw will enable us to cut ¾ inch dry, straight grained, black walnut boards into ⅛ inch strips, smoothly, so as to dispense with planing afterward? A. Make the saw about 6 inches in diameter, of No. 19 gage, 6 teeth to the inch, each alternate tooth to be filed to a very flaring (beveling) edge on the front side. Twist each alternate tooth a very little for the set. Use a fine oilstone on the front part of each tooth after filing, so as to present a wide and very sharp cutting edge to plane the sides of the kerf. File the tops of the teeth square across.—J. E. E., of Pa.

(27) J. L. B. asks: I have three wheels, two of 40 and one of 48 inches in diameter, all of which weigh 38 lbs. Please give me the dimensions for making a tricicle, using said wheels. A. The ordinary method is to have the driving wheel in front, the standard in which it is hung being capable of turning in any direction, at the will of the rider. If your driving wheel would not stand erect, the bearing must have been very short, or the workmanship very poor.

(28) P. B. G. says: I am running a steam pump located 18 feet above the river, and draw the water through 200 feet of suction, and force the water 25 feet above the pump. The suction pipe is 1½ inches in diameter, which is rather small for the pump. When running, the valves and piston thump heavily. I use a foot valve. I would like to know if I can remedy the matter by putting a vacuum chamber on the suction? A. We do not imagine that you will find any remedy other than the use of a larger pipe very efficacious.

(29) G. F. B. says: 1. I am using a foot power lathe for wood turning, and I would like to know what part of 1 horse power I exert in treading said lathe? A. Probably not more than $\frac{1}{12}$ or $\frac{1}{15}$. 2. Of what diameter and stroke should a small engine be to successfully run said lathe? A. Diameter 1½ inches, stroke 3 inches. 3. What horse power does it require to run a circular saw so as to cut up 1 inch hard wood boards to good advantage? A. From 1 to 1½.

(30) W. T. says: I have a 9 inch circular saw, and in the room below a 4 feet 6 inch drive wheel with crank, with a leather belt round the wheel and pulley of mandrel; it is extremely hard work, turning by hand, even to cut thin pine. How can I remedy that or make it easier? A. It will be very hard work turning such a machine by hand. Power stored up in a heavy balance wheel when the saw is not in actual use will assist greatly in making each cut.

I have also a home made machine for teasing hair or wool. It consists of a frame and 2 drums, one about 15 inches, the other 6 inches diameter, with teeth in each. They are made to revolve in opposite ways by a strap over a pulley at the end of each drum, with a crank on the larger one. The hair wraps round the drums and clogs it without getting teased. How can I remedy it? A. I am of opinion that you cannot obviate the difficulty, and that a back and forward or reciprocating motion over a stationary toothed bed would be preferable.—J. E. E., of Pa.

(31) W. H. says: Is there any difference between concussion and weight? If I break a block of iron by dropping a 2 tun weight from a hight that gives it a striking force of 120 tuns, could I break a similar block by placing upon the same space covered by drop weight (about 3 inches in diameter) the same weight, 120 tuns? If not, why? I have broken an anvil block by the above weight. Practical men say that 500 tuns laid on same space would not tear the block. Weight of block, 12 tuns. A. The sudden application of a load, as in the first case, ordinarily has a greater effect than its gradual action, as in the second. One reason for this seems to be that, when a force is suddenly applied, there may not be time to communicate the shock all over the struck body, so as to allow it to offer the maximum resistance before rupture takes place.

(32) E. E. asks: How does an injector compare with an oldfashioned plunger pump for forcing water through a good heater? A. There is a difference of opinion on this subject, the majority inclining to allow a little superior economy to the injector.

(33) L. H. E. asks: In grinding lathe and planer tools, chisels, etc., should the stone run to or from the grinder? A. Towards the operator.

(34) G. T. P. says: We are running a 20 horse engine. The pump would not work to satisfy us, so we blew out steam and water, after taking all the fire out. Three hours after, we commenced refilling by hand pump, letting water in at the safety valve. After the water had been pouring in about 15 minutes, there was a loud noise in the boiler, as though it had been struck with a heavy sledge hammer. Upon examination we found a crack 14 inches long across the crown sheet. Can you tell us the cause? A. Your boiler was probably warm, and the contraction due to putting in cold water produced a strain, causing both the crack and the noise.

(35) J. K. Jr. asks: What is the horse power of the following stream of water? The stream is 7 inches square, flows at the rate of 3 feet per second, and runs on to an overshot wheel whose diameter is 18 feet. A. Find the cubic feet of water that falls per second, multiply this by the weight of a cubic foot of water in lbs., and by the fall in feet, and divide the product by 550. The resulting power is quite small, and possibly some of your data may be incorrect.

(36) J. B. says: A person wishing to build a butcher shop with double board walls thinks that, by leaving between the walls nothing but air, he will do best, while I think that, if he would fill the space up with sawdust, it would be cooler. The walls will be about 6 inches apart. Am I right? A. If the space in the wall could be made perfectly airtight, so that the cool air could not escape and warm air take its place, the air alone would be better than sawdust; but as this is impracticable in your case, you had better fill in with the latter.

(37) C. M. A. says: We are building a three-story school house, with two rooms on each floor; each room is 28x28 feet, and 12 feet high. We are to have one ventilating flue for all four rooms; each room is to seat 60 scholars. How large should the ventilating flue be, and how large and what should be the position of the registers? Each room is heated with a wood stove. A. Build a brick flue, 24x44 inches, between the two rooms in each story, and run up through the center of it a 20 inch diameter heavy sheet iron smoke pipe, kept in place by means of a 4 inch brick cross partition, from the middle of each side, dividing the large flue into 4 shafts or smaller flues, averaging about 10 by 16 inches each. The latter will give you a separate ventilation flue for each room, the air in which will have a constant upward current by means of the heat imparted to it by the central smoke pipe. This pipe should also be divided into 4 parts, to afford a separate smoke flue for each stove. Put in two 14x22 inch registers in each room, one near the floor and one near the ceiling; by these you can grade the ventilation to suit circumstances.

(38) B. D. asks: 1. I have a piece of gold, which has been polished with mercury. What will remove the mercury? A. Heat it strongly over a flame until the mercury has all been driven off. Do not inhale the vapor. 2. Will mercury injure gold? A. Yes. It forms with it a soft amalgam.

(39) E. W. V. asks: Do you know of anything that will take mud off paper? We had a flood in Dubuque, and the water got in our house. Two volumes of Scientific American and *Picturesque America* got wet and full of mud. A. Try the following: Moisten the paper thoroughly and then dry under considerable pressure. When perfectly dry (which will probably require a week or more) the greater part of the clay may be removed by means of a good stiff brush; it will not, however, be practicable to remove, completely, all of the stains.

(40) P. asks: Will water have any mechanical effect on a diamond, falling on it drop by drop, time not being limited? A. Yes.

(41) J. H. asks. What test can be applied to the colors of two samples of woolen fabric to indicate their comparative ability to withstand such exposure to light, heat, etc., as the furniture of an ordinary sitting room is subject to? A. This could best be determined by an analysis of the coloring matter of each.

(42) C. H. asks: How can we purify our cistern water? It has thousands of little semi-transparent "mites" in it. A. Try the addition of several bushels of finely ground well burnt charcoal. It is probable that the pump tube has contaminated the water by decay.

(43) J. S. P. says: The walls of the room in which cotton lint is thrown from the gin are quite rough, and long locks of lint hang from the walls and ceilings. If the gin strikes fire (which sometimes happens) the house is burnt. Would a coating of 1 part liquid sal ammoniac 2 parts sulphate of lime, as given on p. 405, of your vol. 34, or so-called soluble glass, be the best or cheapest for making the room fireproof? A. The recipe is a good one, and we think would offer no little protection from fire. The parts are by weight. By sulphate of lime, plaster of Paris is to be understood.

(44) W B. asks: 1. Is there any truth in the statement that a French chemist has discovered a means of producing a gas 9 times lighter than hydrogen, and non-combustible? A. There is no truth in the statement. 2. Would hydrogen or coal gas preserve or lose its buoyancy if bottled or kept from contact with air? A. It would suffer no change. 3. What would be the size of a sphere of copper filled with hydrogen, made thick and solid enough for safety in ballooning, with a lifting capacity of 300 lbs.? A. If made of copper, it would require a sphere of about 150 feet in diameter. On account of the great weight of the material used, the balloon would be little, if any, stronger in proportion than one of smaller dimension, of lighter fabric, but having a like surplus buoyancy.

(45) W. A. T. asks: Reading in the Scientific American, of March 25, an account of the aqueduct of La Vanne, France, being built of sand, gravel, and cement, it struck me that, if not too costly, such a composition would do in the southern part of California for fencing, as it is very expensive fencing with boards. Do you think, to make walls from 4 to 6 feet high, of the proper thickness, that a less proportion of cement would do? And would it be necessary to put it through a mill? A. Adobe fences are in use in New Mexico, and might be adopted in Southern California. They are built of sun-dried bricks, composed generally of clay and a little straw. Of course a much more permanent fence could be made of cement concrete. No specially skilled labor would be required in its construction, nor any very elaborate machinery. To 1 barrel of cement or good hydraulic lime, 3 barrels of clean sand and 2 barrels of broken stone might be used; the whole should be well mixed together.

(46) A. J. asks: 1. How big a box will just contain 20 bushels of charcoal? A. The bushel contains 2150·4 cubic inches, nearly; therefore, $\sqrt[3]{2150{\cdot}4 \times 20}$ = the dimensions of the box required. 2. Is it right to heap such a box? A. No. 3. What is the legal weight of a bushel of charcoal? A. There is no legal weight for charcoal: it varies greatly in weight, owing to the absorption of moisture and incomplete charring.]

(47) F. Mc. M. asks: How can I take nitric acid out of a mixture, and leave the mixture unaltered? A. You must state the other constituents of the mixture. It is not possible to answer your question without knowing them.

(48) G. A. B. asks: 1. Will common sheet zinc do to put in muriatic acid for soldering fluid, or is a purer quality necessary? A. Sheet zinc will answer perfectly. 2. What is indicated when small, black, irregularly shaped lumps appear floating in the acid after the zinc is dissolved? A. These are the impurities of iron and carbon contained in the metal.

(49) I. H. T. asks: Is there anything that will remove violet ink from woolen goods? A. We do not think you will be able to remove it completely without injury to the fabric. Try hot alcohol and water.

(50) P. M. asks: 1. Where is the proper place to put a ventilating register in a sleeping room, right above the hot air register or about 18 inches down from ceiling downward? A. A ventilating register should not be placed too near a hot air register, as the warm air in that case will have a tendency to pass direct from the one to the other without circulating in the room. A desirable place is on the opposite side of the room, near the floor. It is better, however, to have two registers in the flue, one at bottom and one at top, and graduate the extent of their opening by experiment. 2. What are the right proportions for an ellipse? I generally make one 9 inches in hight for every foot in width; but I do not know the right proportion. A. Ellipses may be constructed of any proportion in harmony with their use. The proportion you have adopted is a good one for ordinary purposes.

Minerals, etc.—Specimens have been received from the following correspondents, and examined, with the results stated:

S. E. E.—It is black oxide of manganese, containing a large percentage of sesquioxide of iron. —N. T. W.—It is galena or sulphide of lead.—H.K. (June 27) It is iron pyrites and chalcopyrite.—J. H. T.—No. 1 is a piece of hornblende. No. 2 is an iron ocher.—J. F. F.—It is a kind of Tripoli powder, used for polishing purposes.—M. F. T.—One is iron pyrites, the other quartz rock and mica.—J. S. H.—It does not contain lead nor silver. A complete analysis would be necessary to determine all of its constituents.—H. E. F.—It is black mica.—W. W. E.—It is galena or sulphide of lead. If in large quantities, it is a valuable ore.—We have received some minerals in a match box, with no letter. No. 1 is a piece of trap rock. No. 2 is a partially decomposed granite, containing iron pyrites. No. 3 is red sandstone. No. 4 is a piece of glass.—H. K. (July 5).—It is decomposed sandstone, not valuable.—E. L. S.—It is a piece of slate, with a little iron ocher adhering.—We are in receipt of a small section of brass pipe, the thread on the outer surface of which is much and deeply corroded. It is labelled "Oneida Community." There is no letter with it.—W. W. N.—Iron pyrites (sulphide of iron).—B. McD.—No. 1 is magnesian limestone, containing crystals of iron pyrites. No. 2 contains silica, alumina, lime, magnesia, and iron.—C. S. B.—The specimen consists of partially decomposed sulphide of iron. We do not think it is of meteoric origin.

E. E. asks: What are the colored fluids put in bottles for display in druggists' windows?—B. C. asks: How can I make a soap for extracting grease and dirt from woolen cloth, without injuring the texture?—C. J. J. asks: How can I polish and color wooden smoking pipes?—W. J. B. asks: What is the best mocking bird food?—T. C. D. asks: What is the lowest point marked by the thermometer in any of the polar expeditions?

COMMUNICATIONS RECEIVED.

The Editor of the Scientific American acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Meteor of July 8. By J. M. D.
On a National Monument. By L. S. B.
On a Little Brag. By Y.
On Irrigation. By F. C.
On Oracles. By A. M. S.

Also inquiries and answers from the following:
E. L. C.—F. W. W.—C. J. G.—C. F. S.—H. W. C.—A. R.—F. S.—J. B.—A. M. S.—J. B. L.—J. S. L.—F. G. B.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who buys white soapstone? Who buys corundum? Who makes the best brass wire? Who sells barometer tubes? Who manufactures Yankee "notions"? Whose is the best rotary engine? Who sells spectroscopes? Who makes the best propeller wheels for steam yachts? Who makes wind wheels? Whose is the best elevator for raising water? Who makes the best flexible hose for conveying water? Whose is the best steam fire engine?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

July 11, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

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DESIGNS PATENTED.

9,384.—SCARF BOXES.—J. H. Fleisch, New York city.
9,385.—TEA SET HANDLES.—E. Haviland, Brooklyn, N. Y.
9,386.—REVOLVER CYLINDER.—W. A. Hulbert, Brooklyn, N. Y.
9,387.—CALENDAR, ETC.—D. C. Newell, Yonkers, N. Y.
9,388.—HANDLE SOCKETS.—W. M. Smith, West Meriden, Conn.
9,389.—DRAWER PULL.—P. J. Clark *et al.*, West Meriden, Conn.
9,390 to 9,392.—CENTER PIECE.—S. Kellett, San Francisco, Cal.
9,393.—HANDLE LUGS.—W. M. Reid, Amsterdam, N. Y.

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We therefore recommend any person who is about to purchase a patent, or about to commence the manufacture of any article under a license, to have the patent carefully examined by a competent party, and to have a research made in the Patent Office to see what the condition of the art was when the patent was issued. He should also see that the claims are so worded as to cover all the inventor was entitled to when his patent was issued; and it is still more essential that he be informed whether it is an infringement, as above suggested, or not. Parties desiring to have such searches made can have them done through the Scientific American Patent Agency, by giving the date of the patent and stating the nature of the information desired. For further information, address MUNN & CO., 37 PARK ROW, New York.

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